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CONTENTS.

Editorial 1067
Telephone Statistics of the U. S. 1070
Programme of International Electrical Congress 1070
The Largest Electric Water Power Plant in New Hampshire—II..... 1071
On a New Standard of Wave-Length. By Dr. James E. Ives..... 1074
Efficiency Curves of Rotary Converters. By A. S. McAllister..... 1077
Government Control of Wireless Telegraphy 1078
An English Municipal Electric Railway 1078
Electric Transportation Within the World's Fair Grounds. By Cloyd Marshall 1081
Performance of Parsons Steam Turbines 1084
Chicago Meeting of American Society of Mechanical Engineers 1086
Dr. Pupin Before the New York Electrical Society 1087
New Telephone Patents 1088
Trolley and Steam Developments in New England 1088
Current News and Notes 1089
LETTER TO THE EDITORS:
The Inventor's Point of View. By Edward P. Thompson..... 1089
Digest of Current Electrical Literature 1090
New Books 1094
New York Central Electric Locomotives 1095
A New Slip Meter. By Franz Welz..... 1096
Long Scale Portable Instruments 1097
Some "Sarco" Specialties 1098
Fort Wayne Series Alternating Street Arc Lighting System..... 1099
Gas Power Plant Extension 1100
Interchangeable Enamel Resistance Units 1100
Truing Commutators 1100
Motor-Driven Contractor's Hoist 1101
Motor-Driven 18-Inch Lathe 1101
Electrically Driven Machine Tools 1101
News of the Week 1102

THE TELEPHONE INDUSTRY.

We present on another page some very interesting statistics, the first compiled in this country, with regard to the telephone industry, as regarded from the public service standpoint, and not including statistics of manufactures, given already in the Census of 1900. The work thus done now by the United States Bureau of the Census is of an extremely interesting and useful character, and these figures supplement admirably those which have already been presented with regard to street railways and central electric lighting plants. It will be seen that the telephone industry represents a capital of just over $450,000,000, covering slightly over 4,000 systems, with 2,315,297 telephones of all kinds, over which were exchanged during the year 1902 the extraordinary number of more than 5,000,000,000 telephone conversations. This industry employed 64,628 wage earners, to whom was paid $26,369,735, and 14,124 salaried officials and clerks, to whom was paid $9,885,886. The revenue derived from the industry reached the splendid total of $86,825,536, which is almost exactly the same as the sum returned for electric lighting central stations for 1902—certainly a striking coincidence—while it is also to be borne in mind that the capitalization of the electric lighting industry is very nearly the same as that of the telephone, being reported at the time mentioned as $504,000,000. The expenses for the year were $61,152,823. The interest on bonds was $3,411,948, and the dividends paid were $14,982,719. It would appear that, exclusive of the interest on bonds, the expenses were just about 70 per cent. of the income.

A very interesting feature of the report is that which shows up the extent to which rural telephony has grown and extended. The report includes 994 mutual systems, which are all of rural character, with 89,316 instruments, and 70,915 miles of single wire. In addition to these the commercial companies operate 15,598 rural lines with 138,426 miles of single wire and 121,905 telephones. Nor was this all, for the report included in addition 4,985 independent farmers' lines, with 49,965 miles of single wire and 55,747 instruments. These figures added to the others quoted above give a grand total for continental United States of 9,136 systems and lines; 4,900,451 miles of single wire, and 2,371,044 telephones.

One of the most interesting features also in connection with these statistics is the power which it gives us to make some kind of comparison between the Bell system as a whole, and that of the "independents" as a whole. Within the last year or two it has become the fashion in some circles to assert that the independent movement by its rapid growth had carried the statistics of independent exchanges so far as to leave those of the Bell exchanges utterly in the shade. The marked development of the independent system is beyond all controversy, but we have pointed out from time to time that the figures available did not altogether justify the claims put forward by some of the more enthusiastic independents as to the minority status into which the Bell system had been thrown. It would appear from the figures before us that the capitalization per telephone installation is about $195. It is generally conceded from the fact that the Bell system is largely centered in the cities, that the capitalization for the Bell installations would necessarily be heavier than for those in the independent networks. Yet even on the basis of $195 over the entire industry, and accepting the Bell stations at the end of 1902 as being only 1,277,983, it would appear that the Bell investment was the larger half. We should not be surprised if out of $452,000,000 aggregate it represented $300,000,000. The total revenue is placed at nearly

$87,000,000, but at only $50 per station the Bell figures would represent at the end of 1902 $64,000,000, or nearly 75 per cent.

The total of single wire for the whole industry is placed at 4,850,486 miles. The Bell system at the end of 1902 had slightly more than half this. The total number of telephone talks is given as slightly over 5,000,000,000 for the whole industry, while the figures for the Bell system for 1902 were given in the annual report of that year as 3,000,000,000. In fact, from whatever point of view the comparison may be made, the Bell system shows up in a favorable light, and must be regarded as holding its own. The increase in the investment in telephony is supposed to reach from fifty to seventy-five millions a year at the present time, but even on this basis the Bell system compares excellently, for the total amount added to construction and real estate by the companies in the system during 1903 was put down at $35,000,000, while in 1902, the year of the Census report, it is even said to have reached $37,000,000. One of the facts, however, that no census can bring out, but which we would all like to know, is, how much of the growth of the Bell system of late years is really attributable to the spur and stimulus of the competition engendered by the independent movement, which has undeniably been one of the most wonderful industrial "booms" of recent years, and one which has brought a maximum of benefit to the public with a minimum of drawbacks.

The Government and Wireless.

A newspaper dispatch announced some days ago that the President's Cabinet had directed the Navy Department to assume control of all wireless telegraph stations on the coast line of the United States and to operate them in the public service in connection with existing land wire systems. While the report has in rather vague terms been contradicted by Secretary Moody, the Chief of the Navy Bureau of Equipment appears to confirm it, and while disclaiming any intention to interfere with the present Marconi station on Cape Cod, gives as a reason for this exception that "The stations * * are for the general convenience and safety of the public, in a broad way supplementing the work of the Hydrographic office." If this means anything it would appear to indicate an intention to develop a coast line wireless service under naval control, which would involve, owing to the matter of interference, the prohibition of further stations operated by private enterprise. Such a policy cannot be too strongly condemned, not only because it involves an extension of military authority over what in times of peace is a purely commercial function, but because of the deadening effect on development of the art that would inevitably result from bureaucratic control.

That some government control over the location and operation of wireless stations is desirable cannot be denied, in view of the experiences with interference at yacht races between rival systems endeavoring to operate simultaneously in the same locality. Such control, however, would appear to come properly under the cognizance of one of the civilian departments of the government—the Department of Commerce, for example—and its details fixed after consultation with the various interests affected, rather than be assumed by a military department and exercised in the arbitrary manner inseparable from military control. Assuming the absence of present plans placing the coast line in a state to meet immediate war, under the suggested plan the wireless organization could very simply be transferred when actual war threatened, from the civilian to the military department. The Navy Department is particularly disqualified at the present time from becoming the custodian of wireless for the reason that in the past it has consistently turned a cold shoulder to American workers in the field. In the announcement of the Bureau Chief above referred to, the partisanship for the German system adopted by the navy—a system which owes its vogue in Germany not to merit but to the personal favor in which the inventor is held by the German Emperor—is displayed, and an entirely uncalled-for fling at the Marconi system indulged in. It would be gratifying if Secretary Moody's disclaimer could also be interpreted to cover the newspaper statements attributed to his subordinate.

Wave-Length Measurers.

The article by Dr. J. E. Ives appearing on page 1074 of this issue contains a number of interesting details and several novel features. Two oscillating circuits are commonly compared in periodic time by establishing an inductive relation between them (transformer fashion), whereby the oscillations produced in one might be aided to set up resonant sympathetic oscillation in the other. Under resonant conditions, the periodic times, or natural periods of the two circuits become equal, and, therefore, the wave lengths of the disturbances emitted by the two circuits become equal. In the ingenious apparatus described by Dr. Ives, the circuit to be tested is connected *conductively* to a small part of the excited circuit, so that a small voltage drop in the latter may be enabled to excite sympathetic resonance in the tested circuit. The connection between the two circuits is made at or near the neutral axis of the exciting circuit, or at the shank of the electric tuning fork, where the oscillation currents find a maximum or ventral segment, but where the oscillating voltage is zero, or finds a node. In this way the voltage brought to bear upon the tested circuit in resonance is only drop voltage due to current traversing reactance, or ix drop; and not the free voltage of the oscillating circuit.

As described in the article, the apparatus is a simple form of Hertzian oscillator, with symmetrical wings, or tuning fork limbs. Each limb has an adjustable Franklin pane capacity and an adjustable inductance. The two capacities are arranged to be matched or balanced. The two inductances are arranged to be symmetrical and to work together, so as to match. The resultant capacity may be varied in twelve steps from 200 abstatfarads up to about 22,500 abstatfarads. The inductance may be varied, by fine gradations, between about 3,600 abhenries and 5,800 abhenries. The wave length is always the circumference corresponding to the geometric mean of the abstatfarads and abhenries as radius; so that the apparatus can measure any wave length from $2\pi\sqrt{200 \times 3{,}600}$, or 5,340 cm. up to $2\pi\sqrt{22{,}500 \times 5{,}800}$, or 71,800 cm. Or, expressing the results in quarter wave lengths, and in feet, instead of in wave lengths and centimeters, the apparatus has a range of quarter wave measurement comprised between about 44 ft. and 590 ft. The quarter wave expression is convenient because it represents the mast height of unloaded wireless telegraph antenna having the wave length and frequency considered. It is a curious coincidence, by no means devoid of physical interpretation, that an abstatfarad is a centimeter in text-book lore, and an abhenry is also a centimeter in text-book phraseology. Consequently, the wave length of any oscillation circuit is the circumference of that circle whose radius is the geometrical mean of the electrostatic centimeters and magnetic centimeters. This is also an easily remembered rule.

The junction of the two wings of the Ives electric tuning fork is made through what appears to be a fairly massive brass rod of 20 mm² in cross-section. The resistance per centimeter of this rod may be one or two microhms, a quantity quite insignificant to produce an appreciable drop of pressure with any ordinary strength of current; but the inductance per centimeter may be, say, 3 abhenries, and at 3 million cycles per second, the mean frequency of oscillation of the apparatus (midway between the extremes produced of 417,500 and 5,620,000), the reactance per centimeter will be 56.5 millions of absohms, or over 1/20 of an ohm. A couple of feet of this brass rod would thus offer a reactance, or impedance, of about 3 ohms to

such a frequency. With an oscillating current of even so feeble a strength as 100 virtual amperes, the voltage drop across two feet of the rod would be about 300 volts. This is quite a respectable voltage with which to attempt exciting an adjacent circuit into resonance, since, at resonance, such a circuit has no appreciable impedance beyond the omic resistance of its conducting parts.

The apparatus can, therefore, be brought into the neighborhood of a wireless telegraph antenna without sensibly disturbing the electromagnetic condition of the latter. The wireless antenna is then cut at the apparatus, and a few inches or feet of the brass rod are inserted in the gap. The capacity and inductance of the oscillator are then varied until the sympathetic frequency of the antenna is struck. The power of oscillating circuits in general, and of wireless telegraph antennæ in particular, as illustrated by the preceding numerical data, is very striking. We look at a 5,000-kw generator as a tremendously powerful machine. We then look up at the slender antenna running to the masthead of an ocean steamer, and are apt to consider the power of the apparatus as trivial because, forsooth, a few storage cells will operate it. The fact is, however, that the power of a wireless antenna is often of the same order as that of the 5-megawatt generator; only the generator keeps down to business and sustains the power steadily, while the antenna oscillates very powerfully for a microsecond or so, and then relapses into quiescence for a relative age.

HIGH VOLTAGE THREE-WIRE SYSTEMS.

Mr. Barnes' Convention paper, describing the 500-volt, three-wire lighting system at Providence, R. I., was received with much interest and aroused not a little profitable discussion. The use of high-voltage —that is, 200 to 250-volt lamps—has come to be somewhat common, particularly in isolated plants, but the development of the idea into a complete three-wire system is much out of the ordinary, and such a system, carrying as in this case more than 80,000 connected incandescent lamps besides motors and arcs, occupies a unique position among central stations. Obviously, the gain in copper by passing from the ordinary voltage for direct-current lighting distributions to 500 volts between the outside wires is very great indeed, and had it been practicable to secure it in the early days of the art it is safe to say that these high-voltage systems would have become common if, indeed, they had not displaced the low-voltage systems altogether. The alternating system came in, however, and crude though it was in the earlier stages of its development, it made plain the fact that economy of copper and wide radius of distribution could be obtained by it in a very simple and effective manner. The motor difficulty, however, remained for some time and not until the polyphase distributions were worked out was it possible to give good motor service with alternating currents. When, therefore, it became feasible to use a three-wire system with toward 500 volts across the outside wires, the field was already fairly well occupied by the polyphase systems.

The most serious consideration in the case of a high-voltage, three-wire system is the possibility of securing efficient and durable incandescent lamps, in the lack of which service must suffer and economy must fall. Five years ago when high-voltage lamps were relatively new they were very far from being satisfactory. The filament of such a lamp is necessarily very long and slender, and it cannot safely be driven so hard as a shorter and firmer filament. The early high-voltage lamps rarely did better than 4 watts per candle, and even at this figure their life was short. Of course, they could be made to do somewhat better in the larger sizes—24 to 32 cp—but these larger lamps have never been favorites in central station practice. At the present time, according to Mr. Barnes, the lamps in use of the Providence system average 3.3 watts per candle when new and have a satisfactory life before falling to 80 per cent. of the initial candle-power. We do not know how these lamps are treated in measurement, but if rated in the same way as lamps of half the voltage the performance is certainly very remarkable. Obviously, however, it is less good than can be obtained with lamps of lower voltage, which are also decidedly cheaper than high-voltage lamps, so that as against saving in copper must be charged up a steady loss of energy, or its equivalent in something else. In the case of alternating distribution, lamps of the highest class can be used and a still very much larger saving in copper can be secured, but at the cost of investment in transformers.

The arc lamp situation is far more serious than the incandescent problem. It is true that by adopting twin lamps the Providence company has been able to maintain an arc service, but of what quality? In the discussion which followed Mr. Barnes' paper, Mr. Woodward characterized the arc lamps as quite satisfactory, but it needs no argument to prove to any of our readers who have ever dealt with enclosed arcs that such an arc operated at 2.3 amp., whether singly or in pairs or groups, gives a light of singularly poor quality. The thin blue arc produced under such conditions is bad as light and most inefficient in production. We have grave doubts whether its efficiency in watts per candle-power is as high as that given by incandescents, and the color is nearly as objectionable as that from a mercury arc. So long as arc lights are a considerable item in central station practice, any distribution with a minimum voltage of about 250 at the customers' terminals is likely to be disadvantageous in this particular. In some cases arcs of large amperage grouped in series may help one over the difficulty, but broadly a high-voltage, three-wire system is at a very grave disadvantage in the arc lighting feature of the programme. On an alternating system at similar voltage one could fall back on Nernst lamps, but even this refuge seems to be denied at present to the direct-current distribution.

The motor service is easily handled on a high-voltage system, and we are disposed to think that fear of alternating motors has been the motive in installing the plant under consideration. It is well nigh impossible to persuade well-seasoned direct-current men—who even yet form an influential coterie—that first-class motor service can be given except by direct-current motors. Yet such is the case, as those familiar with polyphase motors well know. Even the variable speed problems, which are none too easy, can be solved by tact and skill. If the commutating alternating motor, such as is now being exploited for railway service, comes anywhere near meeting the hopes of its inventors, it will be at once available for stationary work. However this may be, the real or imaginary difficulties of alternating motor service are to-day no adequate reason for abandoning alternating distribution in favor of high-voltage three-wire working. Within a somewhat limited range of conditions the latter is unquestionably useful, but save in cases when the supply of energy is extraordinarily cheap, we do not see how it can equal a well-organized alternating system in economy. The mere fact that so high a voltage as 500 has to be used in interior work is serious from the standpoint of safety. Fixtures and accessories adequately safe can doubtless be secured, but either at higher cost than usual or with reduced factor of safety; and a voltage of 500, while not necessarily dangerous to life, cannot be trifled with. It would seem wise, therefore, to go slowly in adopting high voltage for the general work of interior wiring. It is perfectly true that high voltage sometimes gets upon the secondary wiring of an alternating system with disastrous results, but a well-grounded neutral desirable in every class of multiple-wire distribution is an effective safeguard in this particular. The future of electrical distribution depends on the development of new methods of lighting. With our present methods and apparatus, a 500-volt, three-wire system seems a questionable compromise.

Telephone Statistics of the United States.

Mr. W. M. Steuart, chief statistician of the Department of Manufactures in the Bureau of the Census, now part of the Department of Commerce and Labor, has just issued the following preliminary report on the telephone systems of the United States for the year ending December 31, 1902. This report, which is in line with those already issued in regard to street railways and the electric lighting industry, includes all commercial telephone plants, all mutual systems, and all separate "farmer" or rural lines in operation during any portion of the year. It does not include, however, any single lines of an exclusively private character. The inquiry is the first of the kind as to the telephone ever undertaken in this country, and has been extremely difficult on account of the rapidity of recent growth and the heterogeneous nature of the systems.

CONDENSED BALANCE SHEET.

	Total.	Commercial.	Mutual.
Total assets	$452,172,546	$449,485,693	$2,686,853
Construction and equipment (including real estate and telephones)	389,278,232	386,662,619	2,615,613
Stocks and bonds of other companies	9,938,342	9,938,342	.....
Machinery, tools and supplies	9,689,691	9,657,956	31,735
Bills and accounts receivable	30,629,677	30,619,294	19,383
Cash and deposits	12,291,840	12,271,718	20,122
Sundries	344,764	344,764	.....
Total liabilities	452,172,546	449,485,693	2,686,853
Capital stock	274,049,697	273,388,432	661,265
Bonds	73,981,361	73,978,361	3,000
Cash invested (unincor. systems)	6,161,299	4,571,318	1,589,981
Bills and accounts payable	44,491,066	44,411,639	79,427
Sundries	1,124,265	834,561	289,704
Net surplus and reserves	52,364,858	52,301,382	63,476
CONSTRUCTION, EQUIPMENT, ETC.			
Number of systems	4,151	3,157	994
Miles of single wire	4,350,486	4,779,571	70,915
Telephones of all kinds	2,315,297	2,225,981	89,316
Number of subscribers	2,137,256	2,048,736	88,520
Number of automatic pay stations	73,887	73,869	18
Number of all other pay stations	48,393	48,009	384
Farmer or rural lines owned by com. systems:			
Number of lines	15,598	15,598	.....
Miles of single wire	138,426	138,426	.....
Number of telephones	121,905	121,905	.....
Number of party lines	258,166	(1)248,908	(2)9,258
Number of telephones on party lines	886,152	308,571	77,581
Number of public exchanges	10,361	9,419	942
Number of private branch exchanges	7,883	7,883	.....
Manual switchboards, total number	10,842	9,901	941
Common battery system	837	830	7
Magneto system	10,005	9,071	934
Automatic switchboards	54	53	1
Mes. or talks during year, total No.	5,070,555,345	4,971,413,070	99,142,275
Local exchange	4,949,850,491	4,851,416,539	98,433,952
Long distance and toll	120,704,854	119,996,531	708,323
Employees and Wages:			
Salaried officials and clerks:			
Total number	14,124	13,958	166
Total salaries	$9,885,886	$9,871,596	$14,290
Wage-earners:			
Total average number	64,628	63,630	998
Total wages	$26,369,735	$26,206,065	$163,670
Revenue and Expenses:			
Total revenue	$86,825,536	$86,522,211	(3)$303,325
Total expenses (including taxes & fixed charges except int. on bonds)	61,152,823	60,871,002	281,821
Dividends paid	14,982,719	14,981,649	1,070
Interest on bonds	3,511,948	3,511,768	180
Net surplus	7,178,046	7,157,792	20,254

(1) Urban party lines.
(2) Rural party lines.
(3) Includes assessments.

In addition to the reports obtained from commercial and mutual telephone systems, shown in the above table, the bureau secured reports of 4,985 independent farmer or rural lines having 49,965 miles of single wire and 55,747 telephones. These figures added to the totals for the commercial and mutual systems give a grand total for the continental United States of 9,136 systems and lines, 4,900,451 miles of single wire and 2,371,044 telephones.

A number of commercial systems operate in rural districts, but combining the totals for farmer or rural lines owned by commercial systems, mutual systems and independent farmer or rural lines gives a total of 21,577 systems and lines, 259,306 miles of single wire and 266,968 telephones, operated exclusively in rural districts.

In addition to the statistics presented above for the continental United States, reports were received for one commercial system in Alaska and seven in Hawaii, having a total of 4,732 miles of single wire, 2,493 telephones of all kinds, 3,461,000 messages or talks during the year, $112,068 total revenue, $76,307 total expenses (including taxes and fixed charges), and $25,858 paid in dividends, leaving a net surplus of $9,903.

The final report will contain an analysis of the above totals and present detailed statistics by States and for other phases of the industry. This report will be in the nature of a full discussion of the subject, in the manner of the reports that have been prepared nad are also to be published in regard to electric lighting, street railways and electric manufacturing. hen these are all finished the electrical industries of the United States will have received a thorough treatment of the kind, and will have been reviewed so as to present a permanent record of the state of the art and its industries at the beginning of the century. This information, therefore, in addition to its present value, will constitute a basis of comparison for all time.

Programme of International Electrical Congress.

Below is the preliminary programme for Sections B and C of the International Electrical Congress. The programme of Section A has already been published and that of the other five sections will shortly be given out:

SECTION B—GENERAL APPLICATIONS.

Chairman, Prof. C. P. Steinmetz; secretary, Prof. Samuel Sheldon.

Name of Author.	*Title of Paper.*
Prof. E. Arnold,	Direct-Current Commutation.
Dr. O. S. Bragstad,	Compensated Alternators.
Col. R. E. Crompton,	Standardization of Dynamo-Electric Machinery and Apparatus.
M. Andre Blondel,	Calcul des Alternateurs.
Profs. Drs. Elster and Geitel,	Uber die Naturliche Radioactivität der Atmosphare und des Erdbodens.
Prof. Dr. Clarence P. Feldmann,	The Distribution of Voltage and Current in Closed Conducting Networks.
M. A. Heyland,	Self-Regulating and Compounded Synchronous Machines.
W. M. Mordey,	To be announced.
A. Nodon,	Rectifiers.
Sir W. H. Preece,	Electricity in Ancient Egypt.
Prof. C. A. Adams,	Magnetic Leakage in Alternating-Current Machinery.
Mr. C. Day,	Electric Motors in Shop Service.
Mr. J. W. Esterline,	Carrying Capacity of Cables and Conductors.
Mr. H. W. Fisher,	Sparking Distances Corresponding to Different Voltages.
Prof. H. J. Ryan,	The Design of Insulators.
Mr. D. B. Rushmore,	The Regulation of Alternators.
Prof. E. B. Rosa,	The Influence of Wave Shape upon Alternating-Current Meter Indications.
Dr. Clayton H. Sharp,	The Equipment of a Commercial Testing Laboratory.
Prof. H. B. Smith,	Very High Voltage Transformers.

SECTION C—ELECTROCHEMISTRY.

Chairman, Prof. H. S. Carhart; secretary, Mr. Carl Hering.

Prof. Dr. S. Arrhenius,	Methods of Determining the Degree of Dissociation.
Geh. Reg. Prof. Dr. W. Borchers,	Electrometallurgy of Nickel.
Sherard O. Cowper-Coles,	Electrolytic Methods for the Rapid Production of Copper Sheets and Tubes.
Dr. F. Dolezalek,	Subject to be announced.
J. Sigfried Edstron,	Electrical Extraction of Nitrogen from the Air.
Dr. H. Goldschmidt.	Alumino-Thermics.
Prof. Dr. F. Haber,	Electrolytische Zerstörungen in der Erde.
Dr. P. C. L. Heroult,	Electrometallurgy of Iron and Steel.
Mr. J. Swinburne,	Chlorine Smelting.
Prof. W. D. Bancroft,	The Chemistry of Electroplating.
Mr. A. G. Betts and Dr. Edward Kern,	The Lead Voltameter.
Prof. H. S. Carhart and Dr. C. A. Hulett,	The Preparation of Materials for Standard Cells.
Thos. A. Edison,	Alkaline Batteries.
Dr. K. E. Guthe,	The Silver Voltameter.
Mr. Carl Hering,	The Units Employed in Electrochemistry.
Mr. J. T. Morrow,	Notes on Electrolytic Copper Refining.
Prof. J. W. Richards,	The Energy Absorbed in Electrolysis.
Prof. T. W. Richards,	The Relation of the Theory of Compressible Atoms to Electrochemistry.

The Largest Electric Water Power Plant in New Hampshire.—II.

HYDRAULIC power can seldom be developed while the dam intended to maintain the head of water is in detached sections, the canal that conveys the water is incomplete, and the greater part of the electric station to be operated by the water remains unbuilt; but this is being done at Garvin's Falls, N. H. These conditions were made possible by the old dam 700 ft. up stream from the site of the new, by the upper section of the old canal that brings water from one end of the old dam to the head gates of the new canal, and by the fact that one-third of the electric station was completed some months before the other two-thirds were begun.

FIG. 1.—TAIL RACE, GARVIN'S FALLS.

After it was decided to replace the old dam 1,240 ft. up stream from the incomplete electric station, by a new dam some 700 ft. down stream, to replace the lower section of the old canal by a new one of much greater section 500 ft. long, and to extend the electric station, the problem was to discontinue the use of the electrical equipments already installed during the shortest time possible.

This problem was solved by deepening the tail race below the electric station, building the 500 ft. of new canal and extending the forebay wall and station foundations between June 5, 1903, when the contract for the work was signed and November of the same year, when water from the upper section of the old canal was let into the new.

The old canal is unable to bring down the entire flow of the Merrimac River from the old dam even in the summer season, and a coffer dam was, therefore, built a little above the site of the new masonry dam to lay bare a part of the river bed. This coffer dam for the greater part of its length, including that next to the right bank of the river, is built with bags of sand that were transported to their positions by wheelbarrows. Heavy rocks and earth make up the coffer dam in that part nearest the left bank of the river, and a break spanned by a wooden bridge remains open between the end of the coffer dam and this bank for the water that cannot pass down the canal. In this way the water flowing over the old dam was forced to the lowest part of the old channel, while sections of the new dam were built in other parts. The site selected for the new dam was particularly favorable because it afforded a foundation of bed rock all the way across the river with comparatively little excavation. Surface seams in the bed rock on the dam site were filled with mortar, and all loose parts were removed by barring so as to leave a clean surface for the mortar in which the masonry was laid, thereby making a water-tight joint. Any springs flowing up through seams in the ledge were grouted and piped.

Along the entire length of both the high and low-crest sections, the dam, it is set into a trench cut for its entire width in the river ledge. The bottom of this trench is divided into two parts by a projection of the ledge parallel to the length of the dam, and the lower part is that beneath the heel. For the low-crest section of the dam the approximate width of the trench in the bed rock is 31 ft., and the width of the deeper part of the trench, that beneath the heel of the dam, is about 8 ft. In depth the trench varies somewhat with the solidity of the ledge, but the approximate figures are 6.5 ft. at the heel and 4 ft. at the toe of the dam in its low-crest section. The projection of the bed rock in front of the heel of this part of the dam is about 4 ft.

In height the low-crest part of the dam is about 25 ft. above the bottom of the trench at the heel, and 18.5 ft. above the surface of the bed rock outside of the trench. The top of this low-crest section of the dam is at the same elevation as the top of the old dam that is 700 ft. up stream. This equality of elevations will prevent the loss of any flowage rights on the one hand, or any land damages on the other, after the old dam is removed. The great width compared with height in this dam is designed to provide stability against the high freshets to which the Merrimac River is subject. During the highest freshet on record the river at Garvin's Falls reached an elevation of 9.7 ft. above that of the low-crest section of the new dam, on March 2, 1896. The low-crest section of this dam as now constructed has a pressure line that just coincides with the down stream side of its middle third at an elevation 20 ft. below the crest, when the water over this crest is 20 ft. deep. Toe stones in this section of the dam have an elevation 16 ft. below the crest at their upper outside corners, and each of these stones stands about 2 ft. above and extends about 1.5 ft. below the natural ledge beyond the toe. On the up stream side of the dam the batter is 5 to 1, and the space between this batter surface and the side of the trench is filled with concrete. Between the top corner of the toe stones and the natural ledge to a distance of some feet down stream there is a sloping layer of concrete.

At the top corner on the up stream side of the dam the surface to the crest line is curved with a 10-ft. radius. Then comes a horizontal surface 1 ft. wide and tangent to this another surface with a 10-ft. radius turns the down stream corner of the crest. Next is a slope of 5 to 3 for a distance of 7.34 ft., and then comes a concave surface of 10-ft. radius that extends to within 1 ft. of the toe line. This last foot of surface on the down stream side of the dam is horizontal.

Of the total dam length of about 550 ft. between abutments, 75 ft. is taken up by the high-crest section, which juts out into the river from the left bank. The crest elevation of this section is 2 ft. above that of the low crest, and the height of this section above the bed rock is as little as 10 ft. in some parts. This high section of the dam, like the lower one, sets in a trench cut through the bed rock of the river. In width the trench is 8 ft. under the heel, and 22 ft. from heel to toe of the dam. On the up stream side the depth of the trench is 6 ft., on the down stream side 4 ft., and the ledge projection against the down stream side of the heel is approximately 3.5 ft. high. From heel to crest this section of the dam measures as much as 18.5 ft. On the up stream face of the dam the batter is 5 to 1, and on the down stream face it is 5 to 3. In this section the top of the dam is flat save that each corner is rounded with a radius of 1.33 ft.

FIG. 2.—NEW FOUNDATION ARCHES FOR GARVIN'S FALLS POWER STATION.

At the toe of this section the stones of the dam have an elevation about 1 ft. above that of the bed rock just beyond, and a layer of concrete with a sloping surface is used next to the toe.

Each capstone on the crest of the dam along the up stream side, which is cut to shape on its two exposed sides, is not less than 4 ft. square and 2.5 ft. thick, and is secured to the two courses next underneath by 4-ft. long dowels. All the other capstones are also cut to dimensions and are not less than 4 ft. long lengthwise of the crest, and 2.5 ft. deep. The down stream face of the dam as well as the crest is composed of ashlar masonry in both sections, but the

up-stream face of the dam below its crest and also its core is of rubble masonry. The two faces of the dam and also its crest are laid with mortar composed of one part of Portland cement to two parts of sand, and the hearting of the dam is laid with mortar of one part Portland cement to 2.5 parts of sand. Every stone in the dam was required to be laid in a bed of mortar, and no grouting was permitted. In the heart of the dam various sizes of stone were used and regular coursing was avoided so as to obtain good vertical as well as horizontal bonding. For the rubble on the up stream face of the dam every third stone in each course was required to be of headers, and this is also true for the ashlar masonry on the down stream face.

The length of headers in the down stream face is not less than 4 ft., and the length of stretches not less than 2 ft., in a direction normal to the face. The rise of courses is between 18 and 24 in., the minimum face length of stretchers is not less than 3 ft. and that of headers 2 ft. On the down stream face of the dam the width of joints to a depth of 3 in. is ½ in., and in the entire depth of joints the width is not more than 1½ in. Along the entire crest of the dam and for several courses above the toe of the overflow section, the adjoining stones of different courses are secured to each other by dogs. Toe stones in this section are very heavy and have cross-sections about 4 ft. square in plains normal to the face of the dam. All dowels, dogs, clamps and flashboard pins were made of 1¼-in. round wrought iron galvanized, and the dogs were galvanized after bending.

No masonry or concrete in any part of the work was allowed to come in contact with water until it had been in position at least 24 hours. Work in laying masonry in the dam was permitted when the temperature was as low as 22° F., on condition that the materials for the mortar were heated and that salt was mixed with them. All cement used in the dam, canal and power house was of the Portland variety and equal to the best American manufacture. Granite was the only stone used in the dam and other masonry.

The left bank abutment consists of a concrete core wall that extends several rods up into the bank, a cross wall at its river end, and two wing walls for this cross wall. Like all other parts of the dam this core wall is based on bed rock, and its cross-section is tapering, being about 8 ft. wide at the bottom and 3 ft. at the top, with a height not far from 20 ft. Concrete for the core wall was mixed with one part Portland cement, 2½ parts sand and 4½ parts broken stone. Cross and wing walls at the river end of the core wall were built of rubble masonry and ashlar facing. Between the core walls and the wing walls the spaces were filled with layers of earth and small stones thoroughly rolled or rammed.

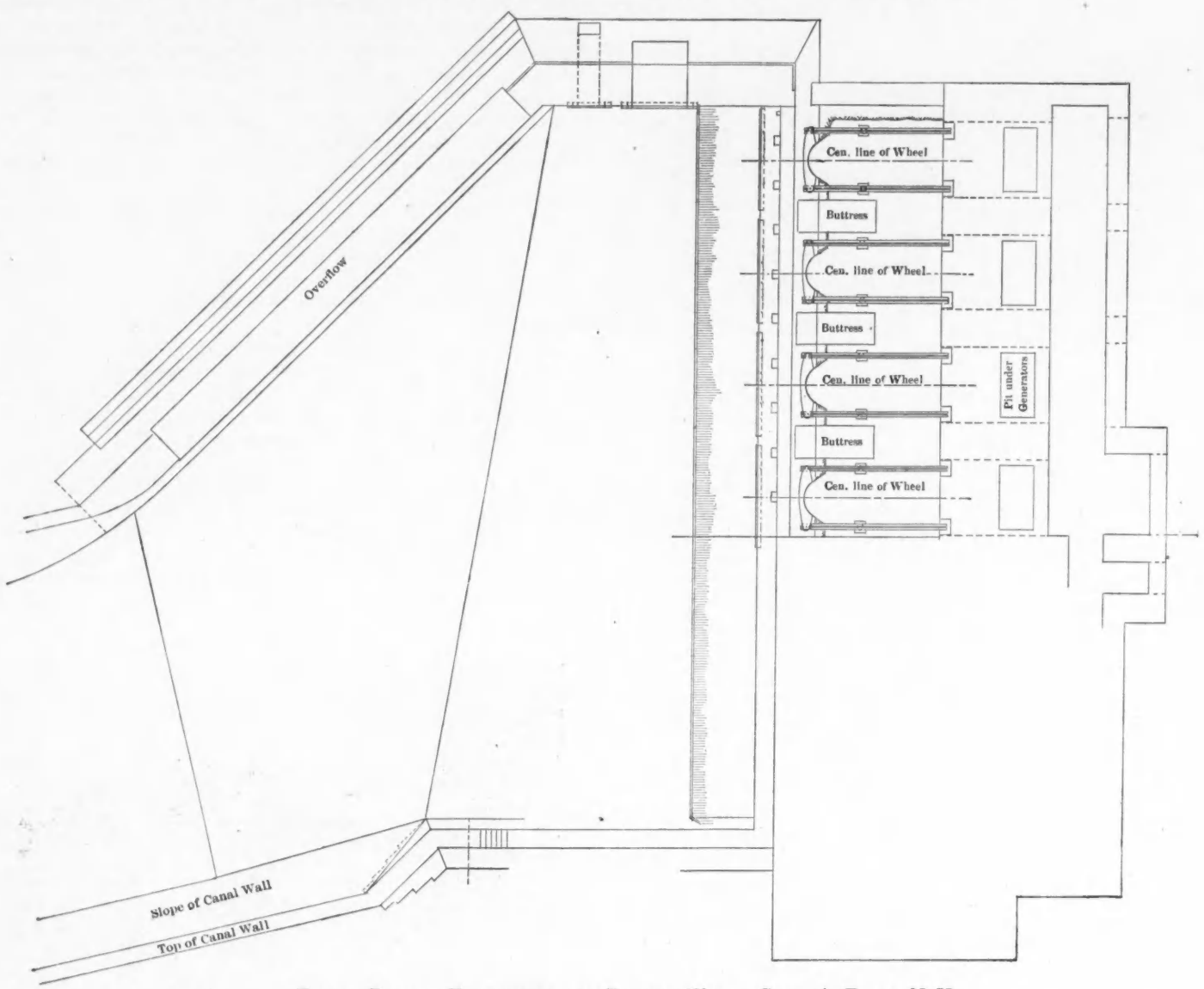


FIG. 3.—PLAN OF FOUNDATION AND FOREBAY WALLS, GARVIN'S FALLS, N. H.

The right bank abutment consists of a cross wall, a wing wall about 60 ft. long on the down stream side, and a wing wall about 139 ft. long on the up stream side. In the length of the down stream wing wall 47.5 ft. forms an overflow section on the river side of the new canal. This overflow section has an elevation 3 ft. greater than that of the low-crest portion of the dam, and 1 ft. greater than that of the high-crest section. At the ends of this overflow section on the wing wall the elevation is that of the main portions of the canal walls or 5 ft. tbove the low crest of the dam. On its river side this overflow section has a batter of 4 in. per foot. In its central portion the cross wall of this abutment has its top 5 ft. above the low crest of the dam. The site of both wing walls at the right bank abutment was a natural ledge that formed the river bank, and this ledge was higher than the present top of the down stream wing wall so that a large amount of rock excavation was necessary both in the bed of the canal and at the site of the wing. Where the cross wall joins the down stream wing a large section of the natural

ledge was left to bind the corners together. Rubble stone masonry faced with ashlar on the river side of the overflow section was used in the down stream wing wall.

The cross wall was built of rubble concrete masonry, and this type of masonry was also used in the up stream wing wall, which is also the head gate wall; above an elevation 5 ft. higher than the low crest of the dam. Rubble concrete for this purpose was mixed with one part Portland cement, 2.5 parts sand and 4.5 parts stone or gravel. No stone of large area in this concrete was allowed within 10 in. of the outside surfaces of the work. Below an elevation 5 ft. above the low crest of the dam the head gate wall is formed of concrete mixed with one part Portland cement, 2.5 parts sand and 4.5

FIG. 4.—UPPER END OF CANAL, GARVIN'S FALLS.

parts stone or gravel graded up to not more than 2 in. in its greatest dimension.

Entrance to the new canal is closed by 95 ft. in the length of the head gate wall, and the remaining 44 ft. of its length forms a wing that runs up into the bank. From the end of this wing a concrete core wall crosses the right of way occupied by the express tracks of the Boston & Maine Railroad which borders the canal. Along its top the elevation of the head gate wall is 15 ft. above that of the low-crest dam, and the width at the base is 30 ft. in that part of the wall that contains the head gates. At its top the width of this wall is 8 ft., its up stream face is vertical and on its down stream face the batter is 4 in. per foot down to a level 12 ft. below the top, where the abutments begin. The base of the wall is pierced by six archways leading from the river into the canal, each of these archways being 10 ft. wide and 15 ft. high. The floor level of these archways corresponds with that of the canal adjoining them, and is 12 ft. below the low-crest portion of the dam. From the floor of the archways to the top of the head gate wall above them the distance is 27 ft. The sill outside of the arches on the river side of the forebay wall is 3 ft. below the arch floors. On its canal side the length of the head gate wall is 90 ft., and the center line of the wall makes an angle of approximately 56° with the center line of the canal. It is consequently necessary for water entering the canal through the head gate arches to change its direction of flow by 34° before passing down the canal.

This change in the direction of water entering the canal begins just inside of the head gate wall, and is effected by a section of the canal wall toward which the flow through the head gate wall is directed. In this section the canal wall is formed of concrete 4 ft. wide at its top and 5 ft. at the thickest part of its base. Natural ledge in which this part of the canal is excavated forms both the foundation and the backing for this concrete section of the canal wall. The entire canal wall between the head gates and the forebay has a top elevation 5 ft. greater than that of the low-crest dam, save in the overflow section already mentioned. Just inside of the head gate wall the elevation of the canal bottom is 12 ft. less than that on the low crest of the dam, and there is a gradual fall in the bottom of the canal so that at the line where it widens into the forebay the elevation is 13 ft. below the overflow portion of the dam. From this it may be seen that the general height of the canal wall is 17 to 18 ft. above the canal bottom. Along almost its entire length of 500 ft. the canal was excavated either wholly or partly in rock, and much of the sides consists of the natural rock surface. At some points such surfaces had large seams and these were dug out and filled with concrete. Along the greater part of the canal the walls were laid with dry rubble masonry, either from the bottom up, where the cut was in earth, or above the top of the natural ledge, where the cut was in rock. These rubble side walls are laid with a slope of 6 in. per foot of height, and is 3 ft. thick. At a distance of about 113 ft. from the down stream face of the head gate wall along the center line of the canal the bottom width shrinks to 62 ft., the width at the elevation of the low crest of the dam to 74 ft., and the width on a level with the tops of its side walls to 79 ft.

The canal holds these widths to a point on its center line that is distant about 144 ft. from the canal side of the end wall of the forebay, and then begins to widen. At the face of this end wall the top width of the forebay is 134.5 ft. Near that cross-section where the canal begins to widen into the forebay the bottom takes on a slope that carries it from an elevation that is 13 ft. below the crest on the river section of the dam down to 17 ft. below that crest, along a line that is 60 ft. at one end and 37 ft. at the other from the inner face of the head forebay wall. Between this line and the head wall the bottom of the canal is level. On the river side of the forebay there is an overflow section 90 ft. long and with its top 2 ft. higher than the low crest of the dam. This overflow section is 8 ft. wide on top, about 19 ft. wide at its base, is 15 ft. high above the natural ledge on which it stands, and is built of rubble stone masonry laid in cement mortar. Between the down stream end of this overflow section and the head wall of the forebay, there is a stretch of wall 40 ft. long on the river side that contains openings for the flush and waste gates. The waste gate opening is 4 ft. wide, of about the same height, and has its bottom approximately on a level with the forebay floor at that point. The opening for the waste gate is 10 ft. wide, has its bottom 10 ft. above the forebay floor and 7 ft. beneath the low-crest level of the dam, and extends to the top of the wall in which it is located, 5 ft. above the low crest of the dam.

Rubble stone masonry laid in cement mortar forms the head wall of the forebay, and this wall serves also as one side of the wheel room in the power station. On top the elevation of this wall is 8.5 ft. greater than that of the low crest of the dam, and its base runs down to a plain 20 ft. below that crest. At its top the thickness of this wall is 3.5 ft., at the low-crest level of the dam, and the flow at line of the canal the thickness is 7 ft., and at the level of the forebay floor the thickness is 10.5 ft. This wall is further strengthened by buttresses that extend into the wheel room between the wheel cases.

FIG. 5.—HEAD GATES, GARVIN'S FALLS.

On its forebay side the head wall of the forebay is vertical and in front of this wall is the steel rack 134.5 ft. long and 20 ft. in vertical height, reaching from the bottom of the forebay to a line 3.5 ft. above the low crest of the dam. The face of this rack is 11 ft. 10⅜ in. from the face of the head wall at the bottom, and 6 ft. 10⅜ in. at the top. In structure the rack is built up with 15-in., 42-pound steel I-beams reaching from top to bottom and spaced with centers 10 ft. 6 in. apart. At their lower ends these 15-in. beams are riveted to a 20-in., 60-pound horizontal I-beam, and at their tops to a 15-in., 42-pound I-beam, while three other horizontal beams tie those running up and down the rack together at intermediate points. The horizontal 20-in. I-beam at the bottom of the rack is set in a bed of concrete and bolted to the natural ledge beneath. At the top each I-beam

running up and down is secured to the forebay wall by an 8-in., 25-pound beam, and at 8.5 ft. from its lower end an I-beam of 10 in. and 40 pounds weight serves a like purpose.

The face of the rack is made up of wrought-iron bars set edgewise, each bar being 3.5 in. wide and ¼ in. thick. Bars are held together by round rods of ⅜ in. diameter that pass through them, and the spaces 1¼ in. wide between bars are obtained by placing a length of standard ⅜-in. iron pipe 1¼ in. long on each rod between each pair of the ¼ by 3.5-in. bars. The face of the rack is divided horizontally into upper and lower sections. In the upper section each of the ¼ by 3.5-in. iron bars is 12 ft. ⅝ in. long and is held in position by four of the ⅜-in. round rods. In the upper section each of the ¼ by 3.5-in. bars is 8 ft. 5¾ in. long and is held in position by three of the ⅜-in. round rods. Vertically the face of the rack was made up of sections most of which were 3.5 ft. wide each.

Beyond the head wall of the forebay and its buttresses the natural ledge beneath the power station was excavated to an elevation 33 to 35 ft. beneath the low crest of the dam, and 16 to 18 ft. below the floor of the forebay. This depth of excavation provided room for the foundations and the escape of the tail water, and permitted an ordinary depth of tail water of at least 5 ft. On a line about 20 ft. beyond the vertical face of the natural ledge that forms the foundation of the main portion of the head wall of the forebay,

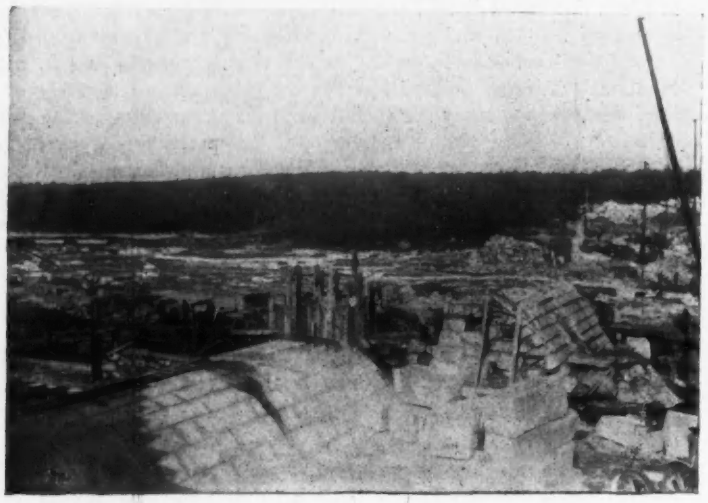


FIG. 5.—BUILDING THE DAM, GARVIN'S FALLS.

and about 10 ft. beyond the ledge projections that support the buttresses, the arches underneath the generator room of the power station begin. These arches, seven in number, form a continuous row from one end of the power station nearly to the other, and the length of each arched opening in this row is 20 ft. Between the up stream face of this row of arches and the foundation of the forebay wall there is no masonry, and the space is spanned by steel I-beams each 27 ft. long that are supported at one end by the head wall of the forebay, and at the other end by the arches just named.

These I-beams are placed in pairs close together, and from center to center each pair is distant about 11 ft. from the next. Two pairs of these I-beams serve to support each wheel case and the draft tubes from the wheel cases drop down between the beams to the tail water below. In the line of arches above mentioned each of the six main archways through which the tail water from the large wheels passes is 14 ft. wide and 16 ft. high above the bed rock floor. Between the archways the walls are 7 ft. thick, and the top of the arch masonry is 16 ft. lower than the crest of the dam. Between the down stream side of this row of large arches and another row of arches that makes up the foundation for the down stream wall of the power station there is an open space nearly as long as the station and 10.25 ft. wide for most of its length. This space is spanned by steel beams and above these beams and the row of arches already described comes the floor of the generator room at an elevation 15 ft. beneath the low crest of the dam, and 13 ft. above the ordinary tail water level. The arched wall that supports the down stream wall of the station is 4 ft. thick and contains seven archways which are respectively opposite to the seven archways beneath the floor of the generator room.

All of this arch work beneath the station is of rubble stone masonry laid in cement mortar, and rests on the natural bed rock. Just outside of the arches under the down stream wall of the station the bottom of the tail race has an elevation 33 ft. less than that at the low crest of the dam, and there is a little slope from this point to the river a few rods distant. The wall of the tail race is dry rubble masonry. To provide for the increased flow of water, the lower end of the tail race was deepened while the extension of the station foundations was in progress.

The kindness of Hollis French and Allen Hubbard, of Boston, the engineers of all the above work, has made it possible to give these structural details of the largest electric water power plant in the State of New Hampshire.

On a New Standard of Wave-length.

BY DR. JAMES E. IVES.

IN a recent number of the ELECTRICAL WORLD AND ENGINEER (February 6, 1904), I have given the results of some measurements of the wave-length of free vibrations in antennæ and closed oscillating circuits. I now propose to describe the *standard of wave length* with which these measurements were made.

This instrument was designed for the American De Forest Wireless Telegraph Company, conjointly by Dr. Lee de Forest and the author. Its general appearance is shown in Fig. 1. It stands 22 in. high, is 30 in. wide and 14½ in. deep. It is symmetrical in form, consisting of two variable condensers, and two variable inductances similarly placed on each side of a spark-gap. The condensers are made of sheets of glass covered with tin-foil, and placed in the base of the instrument. Each of the inductances consists of two concentric circles of wire supported by hard-rubber rings, the outer rings being fixed in a common vertical plane, and the inner, rotating together about a horizontal diameter. The circles and all connecting wires are made of No. 10 bare copper wire (.102 in. in diameter).

Starting at the spark-gap and tracing the connections on the right-hand side, we see that a wire leads to the right-hand condenser; from the condenser a wire passes to the outer circle of the right-hand

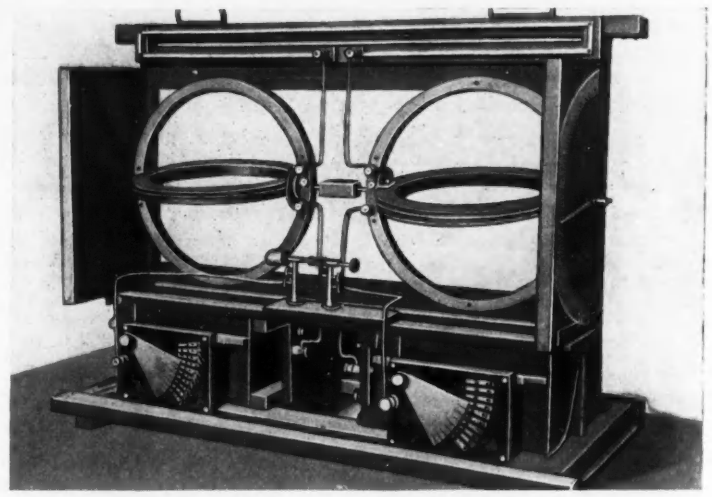


FIG. 1.—VIEW OF INSTRUMENT.

inductance; from the outer circle we pass by means of a sliding contact to the inner circle, and from the inner circle by means of another sliding contact to a wire that goes to the *contact bar* at the top of the instrument. The contact bar is a brass rod of rectangular cross-section, which, as will be seen from Fig. 1, is bent upon itself. The dimensions of its cross-section are ¼ by ⅛ in.

The outer circles of wire are 11¼ in. in diameter, and the inner circles 9⅝ in. The sliding contacts are made by means of two small concentric flat brass rings, which are attached to the inner hard-rubber ring, making contact with two small brushes fastened to the outer ring. The inner hard-rubber rings are rigidly connected so that they must always rotate together. Pointers attached to these rings indicate the angle moved through upon semi-circular dials on the sides of the instrument.

Each of the condensers consists of 43 glass plates, 8 in. square, coated with tin-foil 7 in. square. The plates vary in thickness from 1/32 to ¼ in. The thicker plates are, of course, used for the smaller capacities. The plates are divided into groups of suitable capacity,

ten leads being taken off from the front of the condenser and nine leads from its inner side. As will be seen from Fig. 1, the number of sections used can be varied at will by means of a fan-shaped contact. There are similar contacts on the inner sides of the condensers, directly under the spark-gap, which cannot be seen in the photograph.

The electrical circuit of the instrument is shown schematically in Fig. 2. r_1, r_1', r_2 and r_2' are the outer and inner circles of the variable

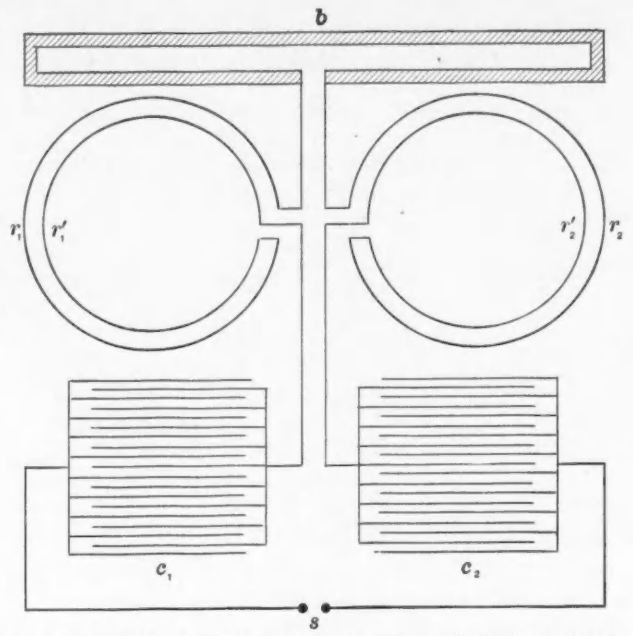


FIG. 2.—SCHEMATIC DRAWING OF THE CIRCUIT OF THE STANDARD.

inductances; c_1 and c_2 are the variable condensers; s is the spark-gap used to excite the system and b the *contact bar,* to which the circuit whose wave length is to be measured, is attached. Both parameters of the circuit, viz.: its inductance and its capacity, are variable. Its resistance can be neglected.

CALIBRATION OF THE STANDARD.

The calibration was made by means of Lecher wires. Two No. 10 bare-copper wires were stretched parallel to each other at a distance of 6 in. apart, and about 4 ft. above the floor, between the end walls of a loft 122 ft. long. The loft was about 50 ft. wide and divided by three rows of wooden pillars into four alleys. The parallel wires were stretched in the middle of each alley, and connected by cross wires at alternate ends, making the total length of parallel wires about 500 ft. (See Fig. 3). They were subdivided into lengths of 12 ft. or less by cutting the wires, making loops at the ends, and tying these ends together with short pieces of heavy cord. When desired, the cuts could be bridged with short pieces of the same wire fitting snugly into the loops. In this manner the parallel wires could be made of any desired length.

To perform the calibration the parallel wires were attached at one

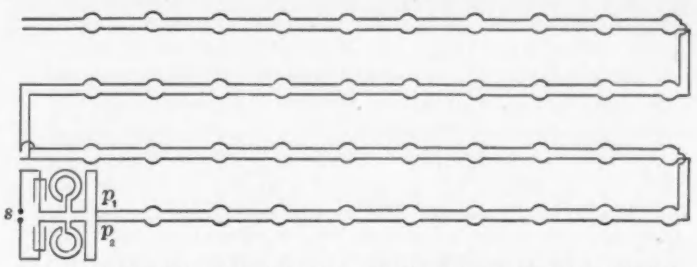


FIG. 3.—DIAGRAM SHOWING THE ARRANGEMENT OF THE LECHER WIRES BY MEANS OF WHICH THE STANDARD WAS CALIBRATED.

end to the points p_1 and p_2 on the "contact bar" of the standard (see Fig. 3). The standard was then excited with a small induction coil, causing a spark to pass between the balls of the spark-gap, s. This sparking produced electrical oscillations in the standard, and also in the Lecher wires, since they were attached to it. A Geissler tube was then placed across the free ends of the parallel wires, and the capacity of the condensers of the standard varied until the tube began to glow. The final adjustment was made by rotating the movable coils until the glow became a maximum. The standard and the Lecher wires were then in resonance; and the *quarter wave length* of the standard was equal to the length of the parallel wires. This process was repeated some fifty times, starting with the wires 40 ft. long, and increasing their length a few feet at a time up to 500 ft. The results are shown in the *calibration curve,* Fig. 4. It will be seen that the curve is made up of twelve sections, each section corresponding to a certain number of condenser leads. For the first section of the curve, we have *one* front lead, and *one* side lead; for the second section *one* front lead and *two* side leads; for the third section *two* front leads and *two* side leads, and so forth. Both condensers must, of course, have the same number of front and side leads. The readings in degrees on the dials are plotted as abscissas,

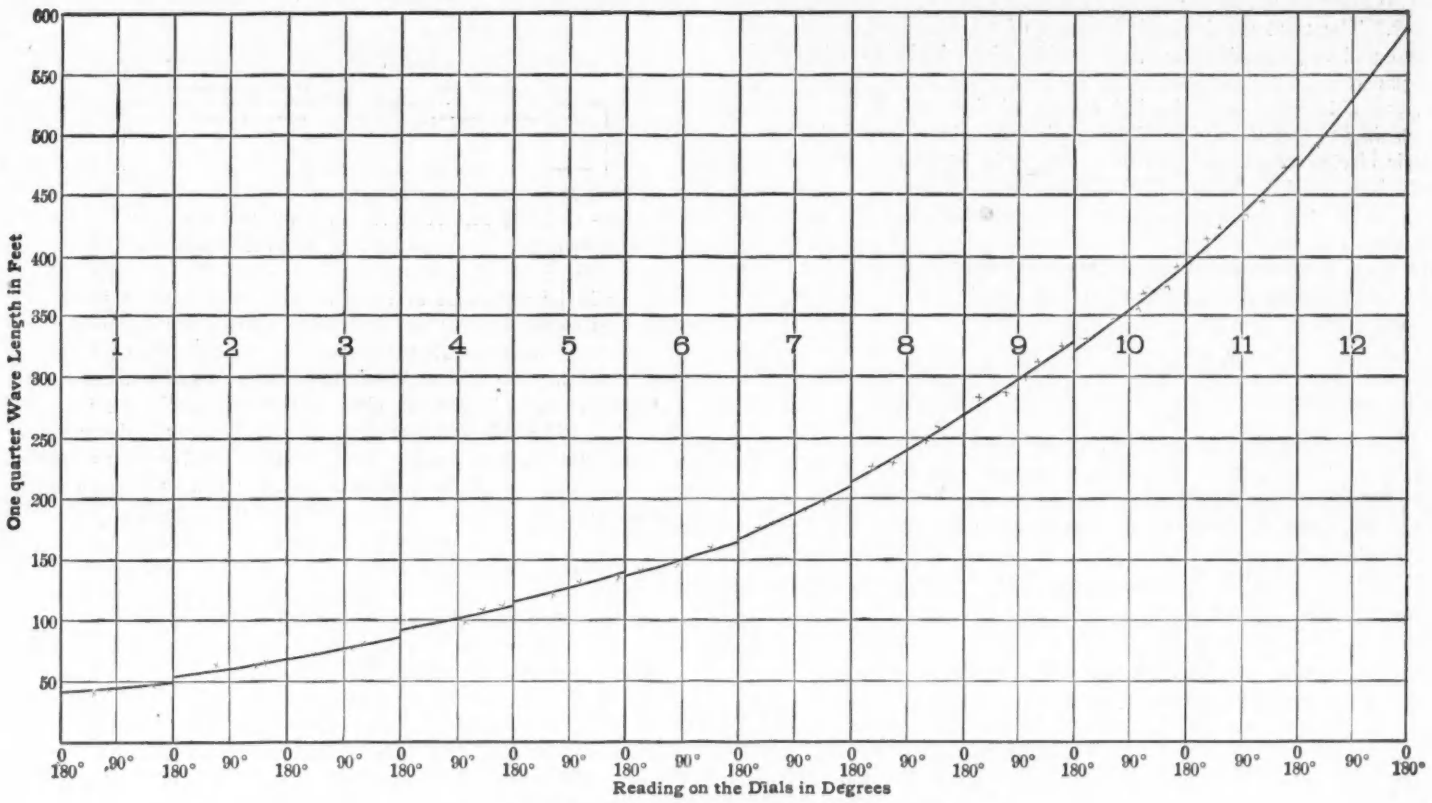


FIG. 4.—CALIBRATION CURVE OF THE STANDARD.

and the quarter wave lengths as ordinates. The curve is broken as it was difficult to adjust the capacities of the successive sections of the condensers, so that the different sections of the curve would fit on to each other.

To test the accuracy of this experimental calibration, the quarter-wave length of the standard was *calculated* for each section, for the movable coils in the position of maximum inductance. This necessitated the measurement of the capacities of the sections of the condensers, and the calculation of the maximum inductance of the concentric circles. The results are given in Table I and show that the observed and calculated values differ from each other only by a few per cent.

TABLE I.

No. of section of curve.	Capacity in microfarads of the two condensers in series.	Maximum quarter-wave-length in feet.	
		Calculated.	Observed.
1	.0248	586	587
2	.0174	490	478
3	.0116	409	390
4	.00815	336	328
5	.00525	269	267
6	.00325	212	208
7	.00204	167	163
8	.00149	144	138
9	.00091	112	110
10	.00054	86	85
11	.00037	63	67
12	.00022	54	50

The maximum quarter-wave length was calculated from the formula

$$\lambda = 2\pi v \sqrt{L C}, \qquad (1)$$

where

λ is the wave length,

v, the velocity of propagation of electric waves, taken in this case as 3×10^{10} cm. per second,

L, the maximum inductance of the standard,

C, the capacity of the number of sections of condenser used.

The inductance of the standard is, of course, equal to the sum of the two inductances, and its capacity equal to half that of either condenser. The total maximum inductance of the standard was found to be equal to 5,830 absolute units or abhenries. This is made up of two parts, viz.: the inductance of the concentric circles, amounting to 4,910 abhenries; and the inductance of the rest of the circuit amounting to 920 abhenries. The minimum inductance of the concentric circles was found by calculation to be equal to 2,670 abhenries. The total inductance of the standard, therefore, when the circles are in the position of minimum inductance is relatively large and equal to 3,590 abhenries. This accounts for the large initial ordinate of each section of the calibration curve.

The inductance, L, of formula (1) is made up of six parts, as follows:

$$L = L_1 + L_2 + 2M_{12} + L_3 + L_4 + 2M_{34} \qquad (2)$$

where

L_1 is the inductance of the left-hand outer circle,
L_2, the inductance of the left-hand inner circle,
M_{12}, their mutual inductance,
L_3, the inductance of the right-hand outer circle,
L_4, the inductance of the right-hand inner circle,
M_{34}, their mutual inductance.

But since $L_1 = L_3$,
$L_2 = L_4$,
and $M_{12} = M_{34}$,

formula (2) reduces to

$$L = 2L_1 + 2L_2 + 4M_{12}. \qquad (3)$$

It was found by calculation that

L_1 = 1,038 abhenries,
L_2 = 855 abhenries,
and M_{12} = 280 abhenries.

To calculate L_1 and L_2, the following formula was used:

$$L = 4\pi R \left(\log_e \frac{R}{g} + .08 \right) \qquad (4)$$

where R is the radius of the circle and g the radius of the wire, both in centimeters.

To calculate M_{12}, the formula for two concentric circles was used, viz.:

$$M = 4\pi R \left(\log_e \frac{R}{d} + .08 \right) \qquad (5)$$

where R is the radius of the inner circle, and d the distance between the two circles, both in centimeters.

METHOD OF USE.

The standard may be used to determine the wave length of a closed circuit or of an open circuit, e. f., of a tuning coil, or of an antenna.

To determine the wave length of the closed circuit, $A\,S\,C$, shown in Fig. 5, we open it at some convenient point and attach it to the "contact bar" of the standard at the points p_1 and p_2. It is now linked to the circuit of the standard, and when electrical oscillations are set up in the standard by a spark at S, oscillations both of current and

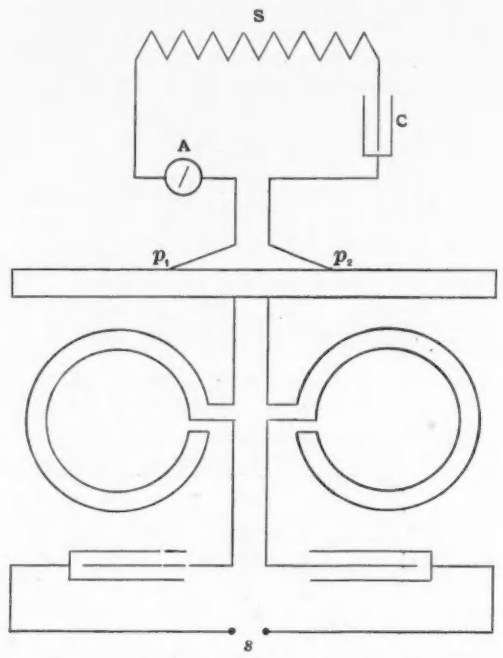


FIG. 5.—DIAGRAM SHOWING MANNER OF ATTACHING A CLOSED OSCILLATING CIRCUIT TO THE STANDARD.

potential will be produced in it, if its resistance be not too great. The amount of the current oscillations will be shown by the reading of the hot-wire ammeter, A, placed in the neighborhood of a current loop. When the two circuits have the same period of oscillation, the disturbance in each, by the principle of resonance, will have a maximum value. The inductance and capacity of the standard are, therefore, varied until a *maximum* deflection is obtained on the ammeter. The wave length of the standard is then equal to that of the unknown circuit.

The amount of the electrical disturbance of the unknown circuit can be regulated by varying the distance apart of the points of attachment, p_1 and p_2, on the contact bar. By bringing these points together, the reading on the ammeter may be made as small as desired.

The connecting wires from the unknown circuit to the contact bar should be heavy, and as near to each other as possible, so as to reduce the inductance of this part of the circuit to a minimum. If insulated, they may advantageously be twisted together. The "contact bar" is relatively heavy, and the inductance introduced by it into the unknown circuit can usually be neglected.

To measure the wave length of an open circuit, such as an earthed antenna, we cut the wire at some convenient point, near to the earth plate, and link it to the standard, as shown in Fig. 6. In the figure, p_1 and p_2 are the points of attachment to the contact bar; a is the aerial wire; E the earth plate, and A the hot-wire ammeter.

GENERAL REMARKS.

This form of standard is compact and covers a large range of wave lengths. One advantage of the symmetrical form is that it can be cal-

ibrated by Lecher wires, these affording a simple and accurate means of calibration.

In its present form the inner circles of wire rotate about a common horizontal axis, and, since they are rigidly connected together, are always in the same plane. Their mutual induction, therefore, remains constant as they rotate. In an earlier form the inner circles were made to rotate about *vertical* axes, and consequently were not always in the same plane. This introduced a variable mutual inductance which disturbed the calibration curve in a peculiar manner, especially for the longer wave lengths. In these sections, the curve became steeper and steeper up to about 120°, and at this point became so indefinite that it was impossible to plot it farther. This trouble disappeared at once when the present arrangement was adopted.

To determine the condition of resonance, both a spark-gap and a Geissler tube were used across the ends of the parallel wires and were found to give the same results. Neither the Geissler tube nor the spark-gap appeared to have any appreciable effect upon the wave length of the wires.

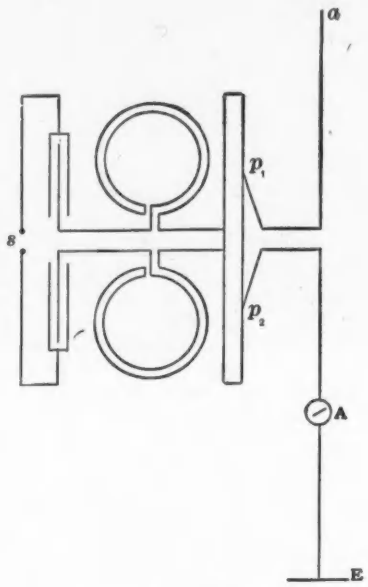


FIG. 6.—SHOWING THE WAY IN WHICH THE STANDARD IS LINKED TO AN ANTENNA IN ORDER TO MEASURE ITS WAVE LENGTH.

Lecher wires are in resonance with any given circuit, if their length is equal to one-quarter of the wave length of the circuit, or to an odd number of quarter-wave lengths. In determining the wave length of a circuit by measuring the length of the parallel wires, most accurate values are obtained by making the wires three or more quarter-wave lengths long, and measuring the distances between the nodes. Some values for the standard obtained in this way, I found to be greater by two or three per cent. than those obtained by using a single quarter-wave length. Since in calibrating the standard I used a single quarter-wave length in each case, the values given in the calibration curve are probably too small by two or three per cent. This supposition is borne out by the difference between the observed and calculated values given in Table I.

In making these measurements, no trouble was experienced from the presence of overtones. In fact, I did not observe any.

I wish to express my thanks to Mr. James B. Gottsberger for his assistance in this work.

Water Power in Germany.

Mr. Langer, U. S. Consul at Solingen, Germany, reports that the German Government is planning water power development in Germany on a large scale, the intention being to find out what there is in the country as to water power and to what extent the same is being utilized. Besides compiling the water level observations since the year 1896, water volumes shall also be ascertained, and furthermore it is intended to obtain information as to the power used by manufacturing plants gaining their energy from water power. It is also suggested to find out how much water power is used for each particular industry, as well as for agricultural purposes. This, in turn, would show which branches of trade should receive the first attention in having water supplied to them for power purposes.

Efficiency Curves of Rotary Converters.

By A. S. McALLISTER.

IN connection with the article by Dr. Kennelly on the "Efficiency Curves of Constant-Potential Transformers" and the editorial comment appearing in the ELECTRICAL WORLD AND ENGINEER for April 16, 1904, and the subsequent discussion thereof by Prof. H. S. Carhart, the following facts concerning the curves of rotary converters may be of interest.

Due to the simultaneous operation of a rotary converter, both as a motor and as a generator, the field distortion from the motor action is to some extent counteracted by that from the generator action, so that under proper field excitation, the field strength remains quite approximately constant throughout a great range of load. Hence, the armature iron loss varies but slightly with the load and, with a degree of accuracy fairly equivalent to that obtaining with constant potential-transformers, the iron loss may be considered to be independent of the load current. The variable loss is due almost exclusively to the copper loss in the armature winding.

The rotary converter with constant impressed alternating e.m.f. considered as a direct-current generator, tends always to produce the same direct external e.m.f. The apparent measurable pressure, however, drops off as the load is applied, due to the copper loss of the armature, and such drop is a direct measure of the loss within the armature.

At any chosen value of load current the sum of this loss in watts added to the output watts of the converter gives a value which would be directly determined by the product of the direct e.m.f. at its no-load value and the load current at its chosen value. It thus appears that with load amperes plotted as abscissas and watts as ordinates the curve of armature output plus copper loss due to load current is a right line and may be drawn at once for any value of output current (Fig. 1). The ratio of the watts loss in the arma-

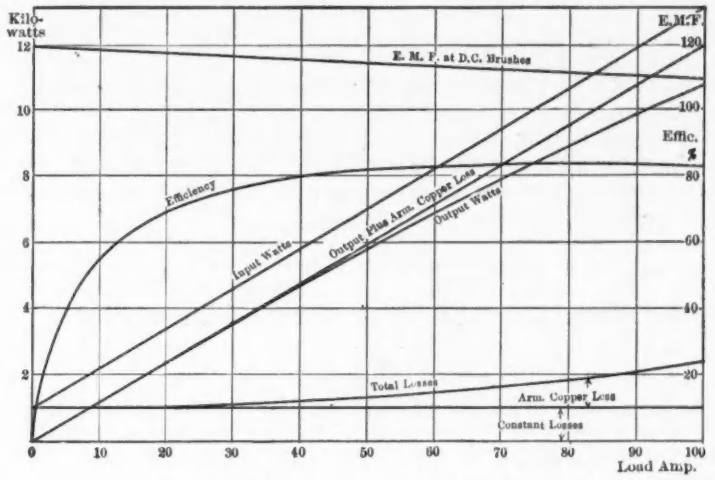


FIG. 1.—CHARACTERISTICS OF ROTARY CONVERTER.

ture copper, due to any load current, to the value of the load current gives the effective value of the armature resistance.

Knowing the no-load losses of the converter and the effective armature resistance the complete performance may be calculated as follows:

Let W = no-load watts input,
R = effective armature resistance,
E = no-load direct e.m.f.,
I = any chosen value of load current;
then I^2R = copper loss of armature due to load,
$E - IR$ = apparent external direct e.m.f.,
$W + EI$ = input,
$EI - I^2R$ = output,

$$\frac{EI - I^2R}{EI + W} = \text{efficiency},$$

which becomes a maximum when $I^2R = W$, *as a close approximation.*

It should be noted that the losses are $W + I^2R$, and that while the ratio of EI to $W + I^2R$ is a maximum when $I^2R = W$, at any armature load current, I, the input is $IE + W$ and not simply IE, as was given in ELECTRICAL WORLD AND ENGINEER April 30, 1904, page 824.

The above equations are based on the assumption of constant iron, friction and windage loss, which assumption is closely exact as stated above. In addition to these losses, the value, W, includes the armature copper loss for the no-load current, and the field copper loss for exciting current. Since for efficient service the exciting current should have a constant value, it follows that the loss from this source decreases as the machine is loaded due to the fact that the direct voltage decreases, requiring less loss in the regulating rheostat. The no-load armature current is of totally an alternating nature and traverses the whole armature winding, and during a portion of its route through the armature is superposed upon that part of the alternating supply current, which is about to be converted to direct current. While its effect alone upon the armature resistance would give a constant value of loss, when the two currents intermingle their combined loss is greater than the sum of the losses of the two considered separately, since in any case $(x + y)^2$ is greater than $x^2 + y^2$. It is thus seen that, among the losses which have a practically constant value, one increases with the load while another decreases, tending somewhat to keep the total at a constant value.

From the above facts and equations it appears that the curves of *constant losses, variable losses, output, input* and *efficiency* may be constructed from the two value, *no-load input* and *effective armature resistance* (Fig. 1).

Due to the fact that the alternating current of the motor portion of the converter flows in general in a direction opposed to that of the direct-current generator portion, the effective armature resistance for polyphase converters is less than that of the same machine used as a direct-current generator. The ratio of effective armature resistance to its true generator value is as follows:

2	rings	converter,	1.39
3	"	"	.56
4	"	"	.37
6	"	"	.26
8	"	"	.21

Fig. 1 gives graphically the results of calculations of the characteristics of a certain rotary converter of which the no-load losses are 1,000 watts and effective armature resistance .125 ohm.

The major portion of what has been given above applies in general to shunt-wound generators or motors, but the assumption of constant armature iron loss is less exact with the later machines than with the rotary converter.

Governmental Control of Wireless Telegraphy.

The report from Washington that the Cabinet, co-operating with the Navy Department, had decided to assume control of all wireless telegraph stations on the coast line of the United States and operate them in the public service in connection with existing land wire systems has been contradicted. Secretary Moody, of the Navy, is quoted as saying: "The newspaper article probably has reference to the authority granted by this department to the Bureau of Equipment for the use of the naval wireless telegraph stations as an accommodation to ships of other navies and the merchant service where there are no commercial stations to receive and transmit messages. As a result of negotiations with the various land telegraph companies, the Western Union and Postal Telegraph Companies have agreed to transmit messages of the character above mentioned received at naval wireless telegraph stations from vessels at sea without holding the government responsible for the toll."

Captain Manney, chief of the Bureau of Equipment, says: "The Government will not in any way interfere with the Marconi station on Cape Cod. These stations have a range of not more than 240 miles out to sea and are for the general convenience and safety of the public, in a broad way supplementing the work of the Hydrographic Office. The reason for taking control of the stations and placing them under one system is to prevent interference on short-distance messages. Arrangements have been made by the Govrnment with both the Western Union and Postal Companies under which the Government turns over to these companies all private dispatches received and the same will be forwarded without prepayment. The system employed by the Government is a modification of the Slaby-Arco, known as the Telefunken, and is used by the German navy entirely."

An English Municipal Electric Railway.

On May 18 the municipal tramway line of Leicester, England, was declared open for public use, having been under construction since April of last year. The system will eventually comprise 19½ miles of double and 3½ miles of single track. Of the equivalent of 42 miles of single track, 33 miles are now completed and work on the remainder progressing. The routes are moderately straight and with no excessive grades, the steepest being 1 in 16 for a distance of about 50 yards. It has been found necessary, however, to lower the roadway under seven railway bridges, in one case as much as 2 ft., in order to obtain sufficient head room for double-deck cars.

The sharpest curve on the system is 37 ft. radius to the center of the track. A minimum radius of 40 ft. for all curves was aimed at, and with one or two exceptions this has been attained. The distance from center to center of tracks with side pole construction is 8 ft. 1 in., giving 3 ft. 4½ in. from gauge edge to gauge edge between tracks, and for center pole construction 10 ft. 11½ in., giving 6 ft. 3 in. between tracks. The gauge of the track is 4 ft. 8½ in.

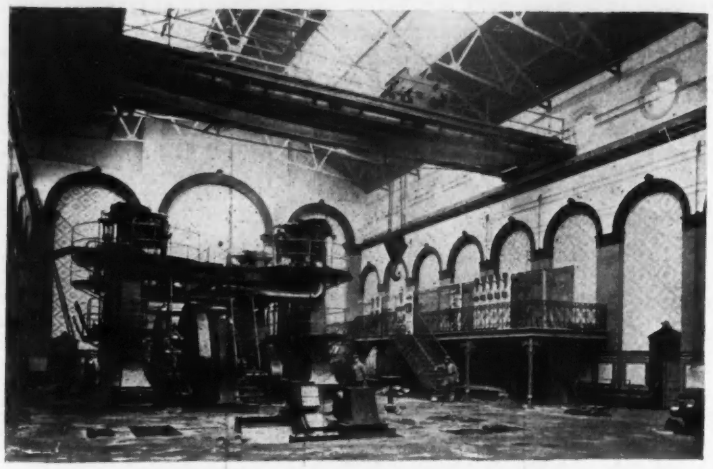


FIG. 1.—ENGINE ROOM, POWER STATION.

In laying the track the ground was excavated to the required depth, and the rails laid and packed up to the required level on wedge-shaped blocks of concrete, 10 in. square at the base and 8 in. square at the top. Where bad ground was met, or the surface worked up owing to inclement weather, these blocks were again supported on circular blocks of concrete, 6 in. thick and 18 in. in diameter, to distribute the weight over a greater area. When the rails were leveled up, a concrete foundation, composed of six parts of granite and Destructor clinker to one part of best Portland cement, was then laid, a space of about 1 in. being left under the rails for packing, great care being taken to make the concrete perfectly solid for a space of 6 in. on each side of the flange of the rails. The space be-

FIG. 2.—EXTERIOR OF POWER STATION.

tween the concrete and the rails was then very carefully packed by means of beater picks with 6 to 1 fine concrete in a semi-dry condition. The total depth of concrete under the rails is 7 in., and under the paving 6 in.

Two solid copper "Crown" bonds of No. 4/0 B. & S. gauge are inserted at each rail joint. The track is cross-bonded every 40 yards and the two tracks every 80 yards.

The power station has been erected centrally to the system, and it is well situated for the delivery of coal either by barge (the canal basin running alongside the boiler house), or by rail. The buildings are faced externally with red sandstock bricks with stone dressings, copings, etc. The station comprises engine room, boiler room, pump room, condenser room, battery room, test room, engineer's office, general office, inquiry office, mess room, fitting shop, stores, engine house lavatory and office lavatory. Bath rooms have been attached to the two latter.

The engine room is 118 ft. by 60 ft. and 40 ft. high to the eaves. It is lighted mainly from the top by means of patent glazing, which has also been used in the fitting shop and battery room. The only side lights in the engine room are bull's-eye windows above the traveler rail. The room is lined internally up to the height up the traveler rail with glazed tiles having patent keyed backs, moulded tiles being carried up to a height of 6 ft. to form a dado. Moulded tiles are also carried round all the arches, wtih moulded faience blocks under the traveler rail. This tiling gives the room a very fine appearance. The entrance hall and the floor in the engine room, except the space reserved for the extra set, have been laid in mosaic.

The boiler room is 108 ft. by 77 ft., and a stoking floor 18 ft. wide

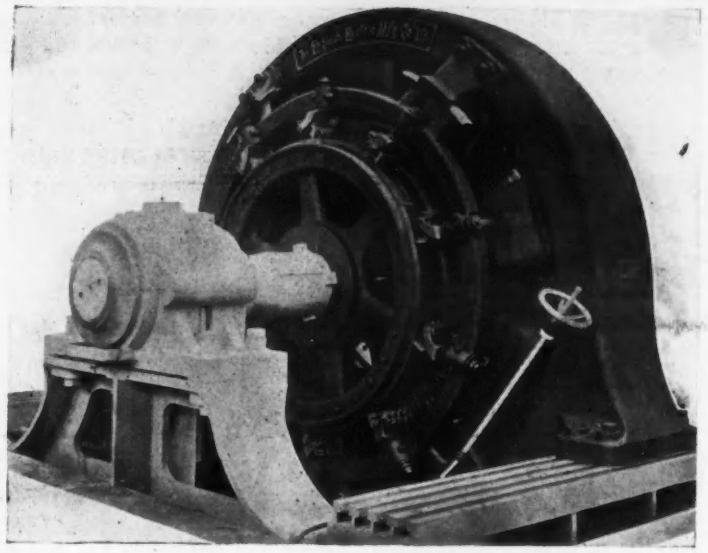


FIG. 4.—ONE OF THE GENERATORS.

house is lighted principally from the roof by means of patent glazing. Windows have also been inserted in the southwestern elevation.

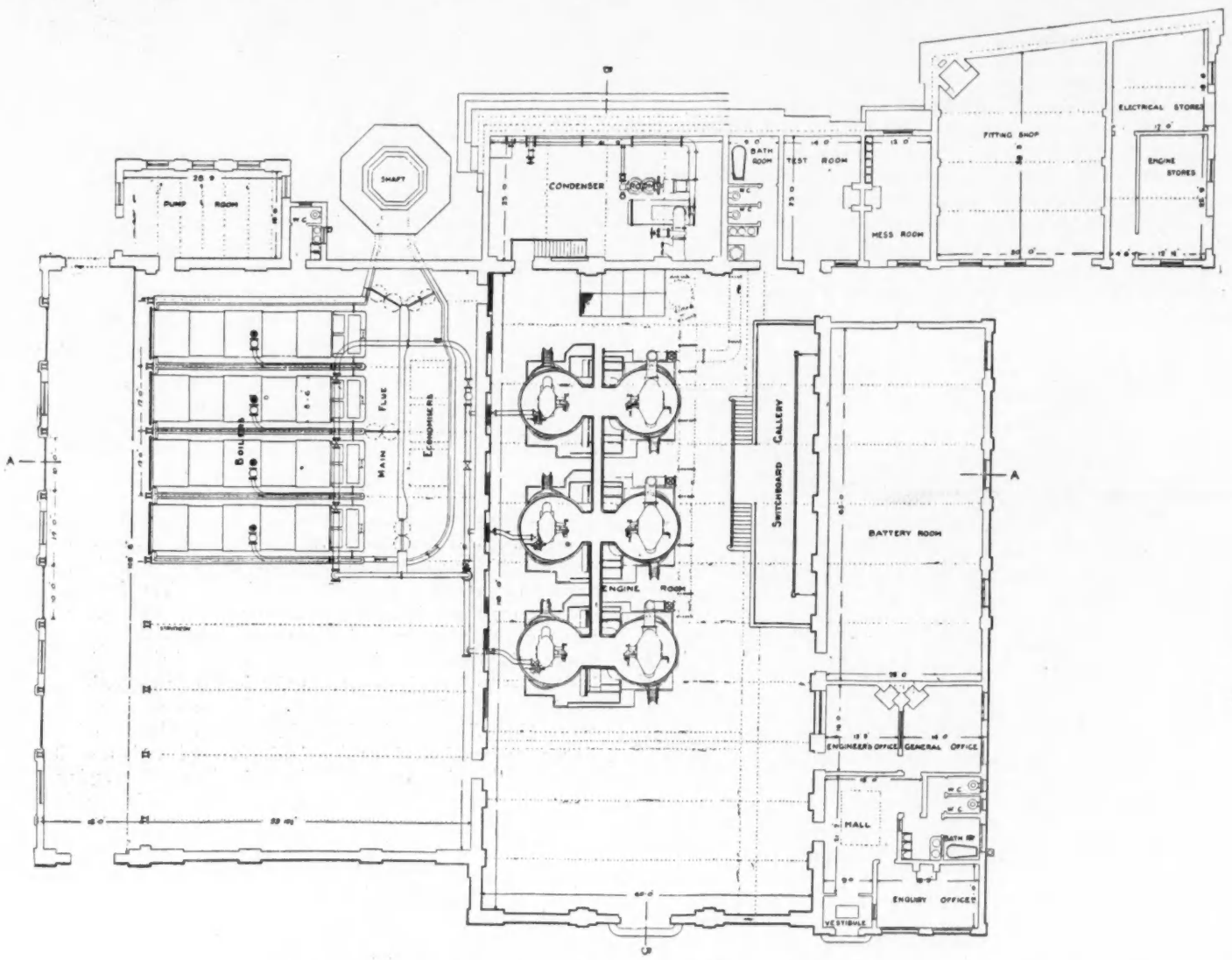


FIG. 3.—PLAN OF POWER STATION, LEICESTER MUNICIPAL TRAMWAY.

extends its full length with an ash tunnel under. At present the stoking floor is covered with a temporary corrugated iron roof. The boiler room has been so arranged that when the coal is delivered by barge alongside it will be lifted by a crane fixed at the northwestern end of the boiler house into a conveyor, and conveyed into the coal bunkers. The conveyor will be continued round and through the ash tunnel for the removal of the ashes. The boiler Kinnear rolling shutters have been inserted in the doorways opposite the fronts of the boilers.

The generating outfit consists of three 500-hp Gates & Thorn vertical cross-compound Corliss condensing engines, direct-connected to the same number of Dick & Kerr railway generators. In addition

to the ordinary governor, which is a very sensitive one, the engine is fitted with a special safety stop, which will operate in case the engines reach a speed of 10 per cent. above the ordinary working speed. It will also stop the engine in the event of any failure of the governor gear, although it does not interfere with the engine taking excessive overloads, even beyond the full range of the cut-

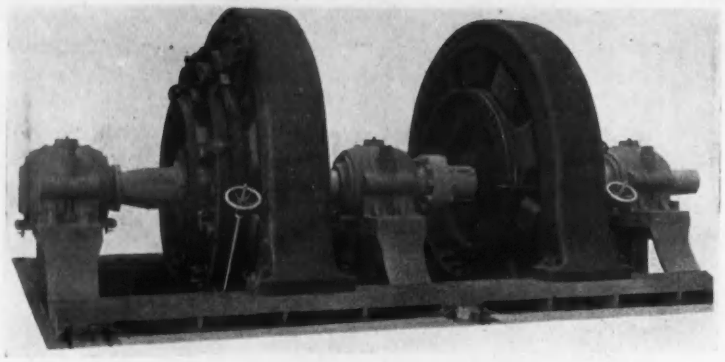


FIG. 5.—BOOSTER.

off gear. The fly-wheel is 16 ft. diameter, and weighs about 25 tons. A very complete system of lubrication has been supplied to these engines, consisting of two ram pumps worked by a drag shaft from the main cranks, and delivering oil under pressure to all the main bearings about the engines.

The switchboard, which was also supplied by Dick, Kerr & Co., consists of twenty-five panels of white marble, controlling, besides the three 500-kw generators, a negative feeder booster set of 20-kw capacity, a positive feeder booster set of 60-kw capacity, an automatic reversible battery booster set of 40-kw capacity, the station lighting and motors and the distribution.

The battery is composed of 240 cells of the Standard Tudor pattern type No. 413 HF 19. It is capable of giving 600 amp. for one hour, or 900 amp. for short periods, and can be charged normally at 270 amp., or at 450 amp. for short periods. The cells are in lead-lined wood boxes, resting on glass oil insulators. The stands are entirely of pitch pine without any metal fastenings, and rest on large porcelain oil insulators. The battery is used in connection with a reversible booster controlled by means of a Thury's patent regulator. This booster has a smooth armature core and tangential

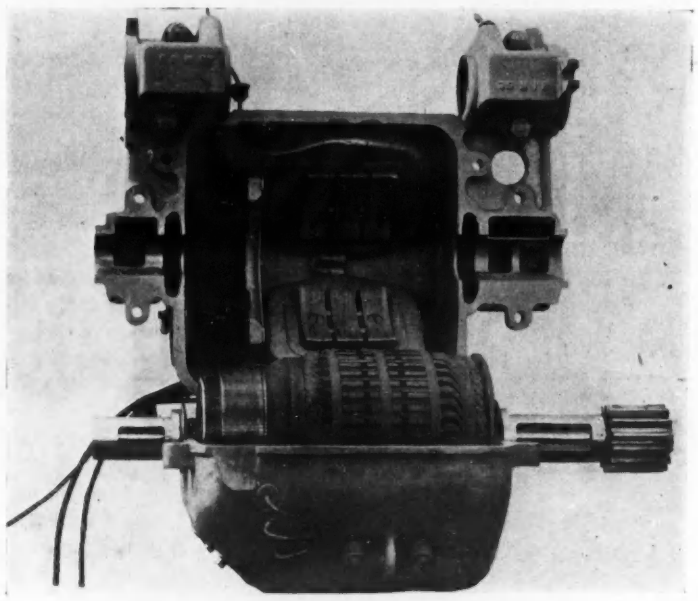


FIG. 6.—VIEW OF INTERIOR OF CAR MOTOR.

field coils. As the armature winding is placed as near as possible to the periphery, and as the field iron is reduced to its possible minimum amount, the machine is most sensitive, and is claimed to act almost as quickly as the load peaks occur.

The overhead equipment has been designed and arranged with a view to obtaining the greatest possible immunity from break-down, also that the fittings should appear as artistic as possible. The design of pole ornamentation was prepared by Mr. Mawbey in conjunction with the Leicester Art School. Span wire construction has been adopted generally, but where streets and roads are wide enough center poles have been introduced, as shown in Fig. —. In the center of the town, where suitable attachments could be obtained, poles have given way to rosettes, except at junctions, these being erected on poles throughout. Each center pole has been fitted with two incandescent gas lamps, and the vase is protected by a neat elliptical guard curb. Side bracket arms have been used on one short length to the number of nine, each 17 ft. 6 in. long, also on the siding to the power station.

The trolley wire is No. 000 B. & S. gauge throughout, except at the car houses, which are wired with No. 0; and the span and guard wire are of galvanized steel, 7-12 and 7-16 respectively. Flexible suspension and double insulation have been adopted throughout. Line fittings of extra strong design have been used throughout, the insulator bolts being of drop-forged mild steel, screwed ¾ in.

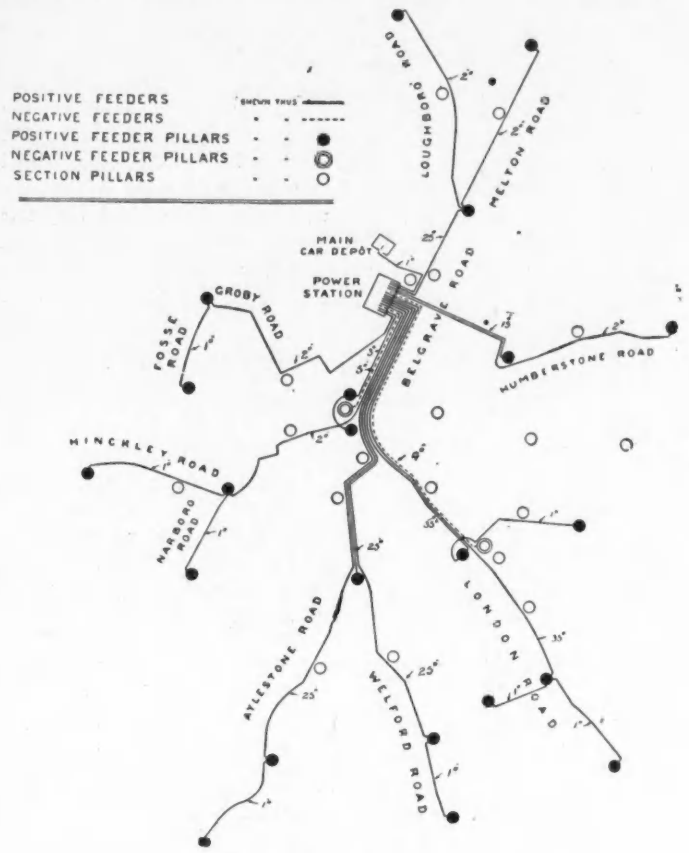


FIG. 7.—PLAN OF FEEDERS.

Four sizes of section and feeder pillars are used. These are fitted with white marble panels, which carry the various quick-break switches, kicking coils and safety fuses for automatically disconnecting the overhead line in case of failure. The feeders are connected up to the main switchboard at the power station through automatic circuit-breakers, which are set to cut out any one of the feeders should a short-circuit occur on any of the sections supplied by that feeder, thus insuring that should a trolley wire break on any portion of the line either the fuses in the nearest section pillars would "blow," or the circuit-breaker at the station would open, rendering that portion of the line dead. Each pillar is also fitted with a Garton lightning arrester, and an ebonite panel carrying the test and telephone terminals. All holes in the panels are fitted with ebonite bushes and washers.

A specially designed telephone shutter, operated by a separate key, has been fitted to each pillar, arranged so that it is unnecessary to open the pillars in order to use the telephone, the jack being inserted from the outside, thus obviating the danger of any one accidentally coming in contact with the "live" fittings in the pillar when using the telephone. The telephone instruments are carried on the cars, one being supplied to each car.

Two negative feeder pillars are erected to meet the present requirements, approximately 1,100 yards and 2,700 yards, respectively, from the power station. They contain the usual instruments to meet the Board of Trade requirements. All section and feeder pillars, and the poles up which the feeder cables have been carried, are bonded direct

to the rails by a 4/0 copper bond, to prevent the possibility of their becoming "alive" owing to break-down of the insulation at these points. The whole of the equipment, including poles, wires, section and feeder pillars, etc., have been supplied and erected by R. W. Blackwell & Co.

All of the cables in connection with this work were supplied and drawn in by W. T. Glover & Co., Limited, of Manchester. Stoneware conduits are used, and are of the patent self-centering type with composition joints. The total quantity of conduits supplied was equivalent to about 80,000 yards of single-way. Throughout the entire system the conduits are laid at the side of the track. The cables are single conductors, insulated with diatrine impregnated paper and lead-covered, jointed by means of lead sleeves wiped on to the lead of the cables. At intervals of approximately ¼ mile the lead covering of the cables is earthed to the rails by means of bare copper bonds, as a preventitive against electrolysis.

Three negative feeders have been carried out to different points of the system, and are connected to the rails through special feeder boxes. Each cable bears a brass label in every box, denoting its size, voltage and termination. The sizes of the feeders range from

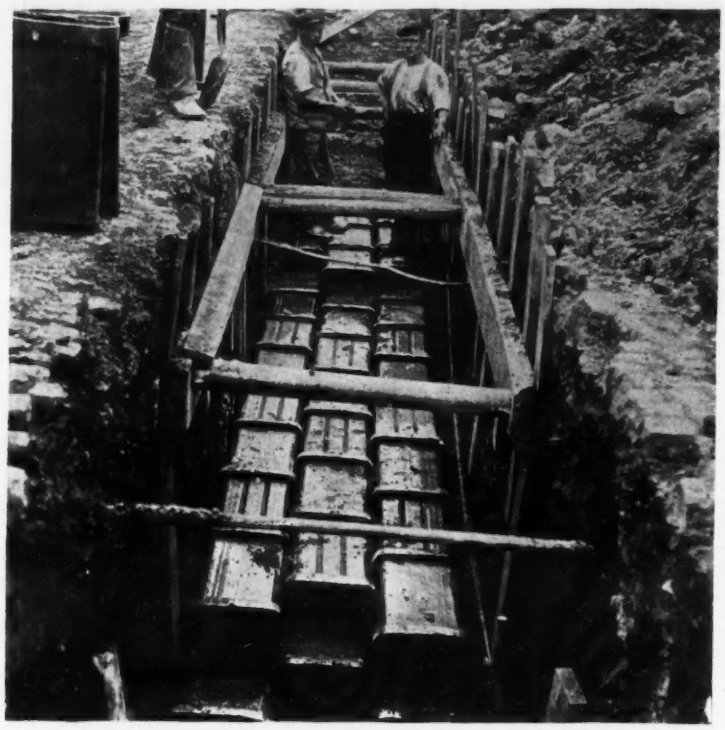


FIG. 8.—CONDUITS AT ENTRANCE TO POWER STATION.

.1 sq. in. to .5 sq. in., the total length being over 20 miles. A complete system of telephone and pilot cables is also drawn into separate ducts along each feeder route, and connected up in every feeder and section box.

All lead-covered cables terminate in the basement of the power station; connection being made to the switchboard with fire-resisting cable of Glover's latest type. In addition to the feeder cables terminating on the switchboard with fire-resisting cable, the whole of the back connections and cable work in the station is also of this description. All of the feeders and pilots were submitted to a pressure of 1,000 volts alternating current for one hour. They were then tested for insulation resistance.

N. E. L. A. Membership.

At the Boston meeting of the National Electric Light Association, which was held last week, an amendment to the constitution was adopted dividing the membership in five classes, as follows: Class A, member companies; entrance fee, $25; annual dues, companies in towns of less than 20,000 pouulation, $10; 20,000 to 300,000, $25; over 300,000 population, $50. Class B, members; entrance fee, $5 and annual dues $5. Class C, associate member companies; entrance fee, $25; annual dues, $20. Class D, associate members; entrance fee, $5 and annual dues, $5. Class E, honorary members; no entrance fee; annual dues, $4.

Electric Transportation Within the World's Fair Grounds.

BY CLOYD MARSHALL.

FIG. 1.—LAUNCH ON THE LAGOONS.

NEW problems of transportation arise as each international exposition grows in extent, and these have been met at St. Louis in several ways. The first and most important means of transportation about the grounds is by the intramural railway, which is a complete electric railway system consisting of seven miles of double track encircling the grounds and running nearby each important building. Its operation is similar to that of an elevated railway with stations at convenient points and a uniform fare of ten cents for all or any part of the trip. Such a means of communication is a real necessity, not simply catering to the pleasure to the visitors. This has recently been demonstrated. The intramural track has formed an important portion of the railroad system within the grounds. Since the Exposition opened, all cars with exhibits and materials have been switched on the sidings or into the buildings at night. To permit this the intramural cars have ceased running at 10.00 o'clock, which is about the time when the visitors are enjoying the amusement features of the Pike. Those who wish to return to the Inside Inn or go to the opposite entrances have to walk about two miles, and, therefore, have made loud objections to the intramural schedule. A complete circuit around the grounds by means of the intramural railway is perhaps the best introduction to the whole Exposition that the visitor can have. He will be impressed by the vast extent of territory covered, the beautiful arrangement of the grounds, and the size and number of the Exposition buildings.

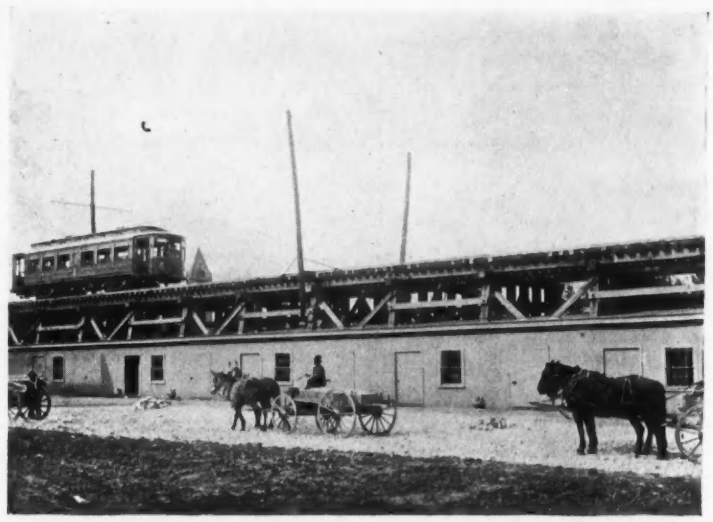


FIG. 2.—ELECTRIC RAILWAY IN GROUNDS.

A trip which is even more enjoyable and instructive is one on an electric automobile through the heart of the Exposition. This is the first World's Fair at which such a service has been rendered, and the generous patronage received indicates that it meets an actual want. The World's Fair Automobile Transit Company has secured a large number of electric vehicles and will have over one hundred later in the season. This service has been available for over a year. As many as 3,500 persons have patronized the automobiles in one day during the pre-Exposition period. The regular route covers the center of the Exposition and a visit to each of the exhibit palaces. At intervals a stop is made, and the chauffeur explains those things which interest his passengers. A fare of twenty-five cents is charged.

If the visitor wishes the exclusive use of a vehicle, he can hire a cab or brougham at a rate of $4 per hour and take his friends to any part of the grounds he may desire. There is but one forbidden roadway, which is between the Louisiana Purchase Monument and the Grand Basin, and over this no vehicles can pass.

The company also has a number of large automobiles running from the principal hotels in the city into the Exposition grounds. The fare for this ride is 50 cents. Arrangements are also made to meet parties or delegations at the trains and convey them to the grounds or to the Inside Inn. A special gate into the grounds is provided for the automobiles. The automobile service begins at 8.00 A.M. and continues until 1 o'clock at night. While the intramural is not running after 10 o'clock, about ten automobiles are used at night carrying the pleasure seekers on the Pike to the Inside

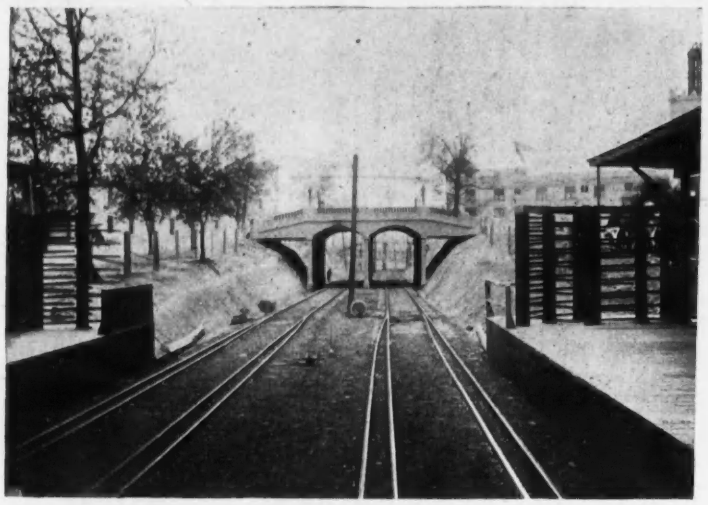


FIG. 3.—STATION ON ELECTRIC RAILWAY.

Inn or to the distant entrances. In order to reduce the fire hazard, all gasoline automobiles are excluded from the grounds, which leaves the field exclusively to storage battery vehicles. The World's Fair Automobile Transit Company had no precedent by which to gauge the needs of such service, and had no standard of equipment. There are a number of different types of vehicles in use, some of which have been acquired from the Buffalo Transportation Company, the Boston Auto Express Company and others, the vehicles being modified to suit the local conditions. One of the landaus in use was that which

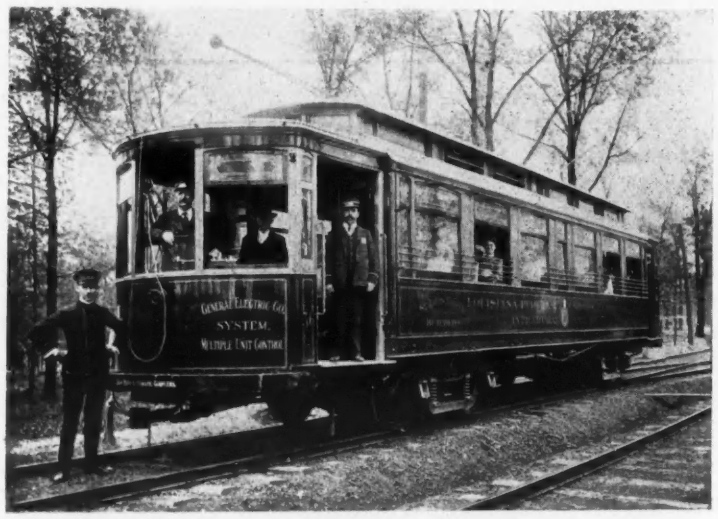


FIG. 4.—A CAR ON THE ELECTRIC RAILWAY.

conveyed President McKinley to the Music Hall at the Pan-American Exposition before his assassination.

Recently a number of large tally-hos seating forty persons have been put in service between the grounds and the hotels. The Electric Vehicle Equipment Company has furnished a number of buses with a capacity of eighteen passengers. Fifty 20-passenger brakes are now being delivered by the Auto Car Equipment Company, of Buffalo. Not less than thirty cabs, landaus and broughams are to be in commission. The automobile company has made an excellent record, as not one accident of any kind has occurred with their vehicles. This is due largely to a rigid system of inspection to keep the automobiles in good condition, and to the careful instruction of all its operators. There is no prescribed speed regulation, because fast driving would defeat the purpose of the trip, which is to give the passengers a chance to comprehend the beautiful surroundings. The automobiles seldom if ever exceed eight miles an hour. Each driver must be an experienced chauffeur and before taking charge of a vehicle is tutored by an instructor with reference to the care and operation of the automobile and also regarding the fact and figures about the exposition which will be of interest to his future passengers.

The company has built a garage and charging station at the east

FIG. 5.—VIEW ALONG THE TRACK.

end of the Model City and near the De Forest tower. Three 50-hp gas engines are belted to Edison 110-volt generators to supply the current. The leads extend to the charging plugs along one side of the building where fifty-five batteries can be charged at a time. Another charging station is down town at the corner of Thirteenth and Locust Streets. There are two batteries or sets for each automobile, so that each vehicle can be kept in continuous service, one battery being charged while the other is in service. The battery is carried beneath the body of the automobile, and when it is to be leased

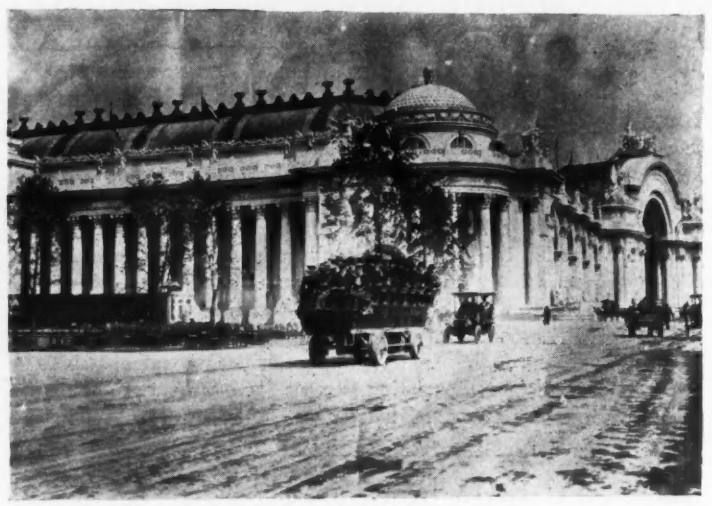


FIG. 6.—LARGE AND SMALL AUTOMOBILES ON GROUNDS.

the vehicle is run over a lift which is level with the floor. A wheel truck is pushed over the lift and under the battery. It is then raised to receive the battery, and when lowered is moved to a charging plug. There are four of these lifts operated by Ingersoll-Sargeant oil pumps driven by electric motors. Six batteries can be removed and replaced every ten minutes. The charging generators are kept at 110 volts, and the current charge to each battery is regulated by a rheostat. As there is an attendant at the generators and at the batteries all the time no automatic overcharge or release

is employed. The batteries receive charges once a day, which is sufficient for a twenty-five-mile run. Once a week each battery is discharged under the observation of an expert and readings are taken every five minutes. Any necessary repairs or renewals are made at this time. When fully charged the density of the electrolyte is kept at 1,300, which falls to about 1,250 at the end of normal discharge. The plates for these batteries are shipped direct from the Electric Storage Battery Company and assembled and the connections burned together at the station. Wooden separators are employed as they seem to give better results than rubber. All batteries have forty-two "exide" cells, with from nine to nineteen M. V. plates, depending upon the size of the vehicle. The motors are

FIG. 7.—SMALLER PASSENGER AUTOMOBILE.

either General Electric or Westinghouse, of 80 volts and 20 to 35-amp. capacity, with series parallel control.

After a circuit of the grounds in an automobile has been made during the day, the visitor will find great pleasure in a launch trip about the lagoons during the evening. The most beautiful effect imaginable is during the illumination when the myriad lights on the buildings are reflected in the placid waters of the Grand Basin and lagoons. A journey of two and one-half miles can be made through the Grand Basin across the base of the Cascades around

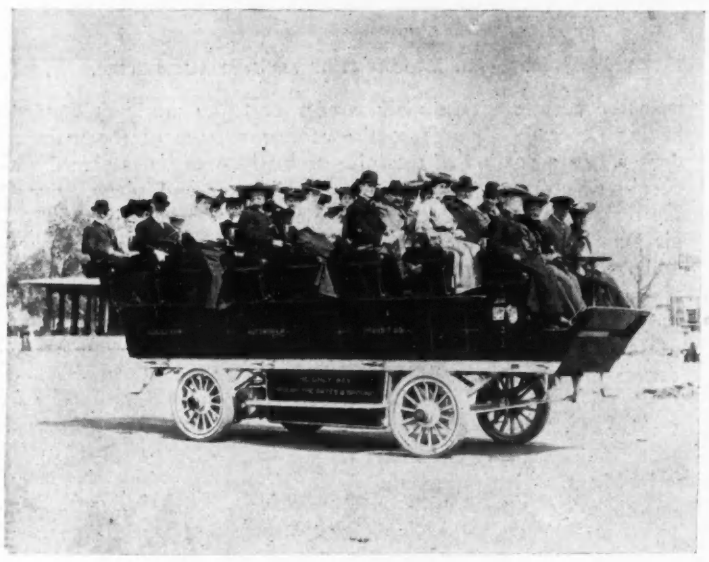


FIG. 8.—LARGE PASSENGER AUTOMOBILE.

the Palaces of Electricity and Education, and past the Machinery, Varied Industries, Manufacturers', Mining and German Buildings. During the daytime the launches are covered with awnings to make it comfortable for passengers in the heat of the day, but in the evenings the sun shades are removed. The Launch & Gondola Concession Company has thirty-one electric, five gasoline launches and fifteen gondolas. The gasoline launches are made in fantastic designs representing swans, peacocks, dragons, etc. The gondolas are imported direct from Venice and the singing Venetian gondoliers who accompany them have been selected both for their voice and for their skill with the oar. The launches are thirty-five feet in length and seven beam, and draw thirty inches of water when loaded. About forty passengers can be carried and the fare for the trip is twenty-five cents. The electric boats travel at the rate of four and one-half miles per hour and make the circuit in about a half hour.

The launches, which were made by the Truscott Boat Manufacturing Company, are equipped with Willard batteries. Each contains forty-four cells of 140-amp.-hour capacity, the positive plates having the new type Willard envelope, which gives excellent results by preventing to a great extent the shedding of active material. Each battery is divided into two parts, which by means of a Hertner

FIG. 9.—LAUNCH ON THE GRAND BASIN.

series parallel controller gives three speeds forward and two on reverse. The motors were supplied by the Hertner Electric Company and are of 2-hp, compound-wound, four-pole, with ball, thrust and axle bearings. On account of the slack water and the lagoons being sheltered from the winds, a boat will run 100 miles on a charge. At present they are in service from five to six hours a day, and the busiest time is from 5 to 10 P.M.

The charging station for the launches is under the bridge just west of the Electricity Building, from whence is received a 250-volt supply of current. Along the bank are leads to thirty-two Anderson automobile charging plugs, two batteries being charged on each circuit. At the switchboard are the wattmeter, volt and ammeters, pilot lamps

FIG. 10.—ANCHORAGE FOR LAUNCHES.

and Wirt rheostats for regulating the supply of current. Mr. H. B. Barnes, who is in charge of the station, has arranged the voltmeter and pilot lamp circuits so that he can tell at a glance the condition of charge of all batteries connected. The normal charge rate is 25 amp., and the charge is continued until the cells average about 2.55 volts. The electrolyte is maintained at a density of 1,250 at full charge and about 1,200 when the cell is discharged.

By a judicious patronage of the intramural, the automobiles, launches and roller chairs the visitors can cover the great area within the World's Fair grounds without undue fatigue or expense.

Performance of Parsons Steam Turbines.

In a paper read before the May meeting of the British Institution of Electrical Engineers, the Hon. Charles A. Parsons presented a paper on the steam turbine as applied in electrical engineering, which includes the data of a number of tests of electric turbine generating plants made by various consulting and central station engineers. Referring to the design of the Parsons turbine, it is stated that some of these were formerly made of the tandem type, in which the expansion of the steam was first carried out in a high-pressure cylinder and then completed in a low-pressure cylinder, but it was soon found that better economy, except possibly in very large sizes, could be obtained by having the whole turbine in one cylinder.

Fig. 1 is a curve from the paper showing the effect of varying vacua in the case of a turbine at Hulton colliery operating a 300-kw,

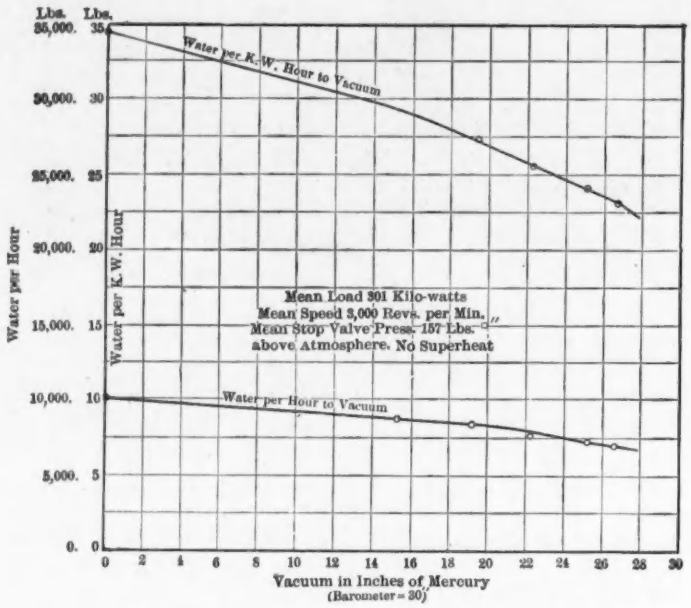

Lbs. Lbs.
35,000. 35
30,000. 30
25,000. 25
20,000. 20
15,000. 15
10,000. 10
5,000. 5
0. 0
Water per Hour
Water per K. W. Hour
Water per K.W. Hour to Vacuum
Mean Load 301 Kilo-watts
Mean Speed 3,000 Revs. per Min.
Mean Stop Valve Press. 157 Lbs. above Atmosphere. No Superheat
Water per Hour to Vacuum
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Vacuum in Inches of Mercury
(Barometer = 30)

FIG. 1.—CURVES SHOWING EFFECT OF VARYING VACUA.

three-phase alternator. In Fig. 2 are curves from a 1,500-kw turbo-generator in the plant of the Sheffield Corporation, the turbine driving a two-phase alternator supplying current at 2,000 volts.

Mr. Parsons states that tests show that under the conditions of,

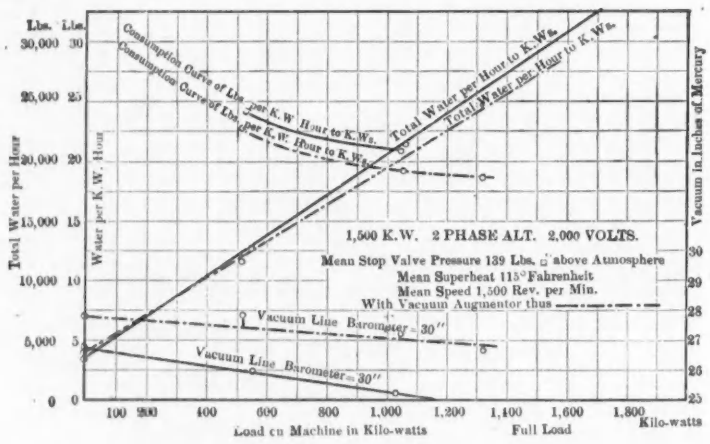

Lbs. Lbs.
30,000 30
25,000 25
20,000 20
15,000 15
10,000 10
5,000 5
0 0
Total Water per Hour
Water per K. W. Hour
Vacuum in Inches of Mercury
Consumption Curve of Lbs. per K. W. Hour to K.Ws.
Consumption Curve of Lbs. per K. W. Hour to K.Ws.
Total Water per Hour to K.Ws.
Total Water per Hour to K.Ws.
1,500 K.W. 2 PHASE ALT. 2,000 VOLTS.
Mean Stop Valve Pressure 139 Lbs. above Atmosphere
Mean Superheat 115° Fahrenheit
Mean Speed 1,500 Rev. per Min.
With Vacuum Augmentor thus
Vacuum Line Barometer = 30"
Vacuum Line Barometer = 30"
100 200 400 600 800 1,000 1,200 1,400 1,600 1,800
Load on Machine in Kilo-watts
Full Load
Kilo-watts
30 29 28 27 26 25

FIG. 2.—PERFORMANCE CURVES OF 1,500-KW TURBO-GENERATOR.

say, 140 pounds steam pressure, 100° F. superheat and a vacuum of 27 in. with the barometer at 30 in., the steam consumption of turbo-generators are, in round numbers, as follows:

A 100-kw plant takes about 25 pounds of steam per kw-hour at full load, which figures become 22 pounds for a 200-kw plant; 20 pounds for one of 500 kw; 19 pounds for one of 1,000 kw; 18 pounds for a 1,500-kw plant, and 16 pounds for a 3,000-kw plant. These figures are stated to be derived from averages of a large number of tests which have been made from time to time. Without superheat the consumptions are about 10 per cent. more, and each 10° F. superheat up to about 150° F. affects the consumption by about 1 per cent.

In a turbine the benefit derived from the vacuum is much more than in a reciprocating engine, every inch of vacuum between 23 and 28 in. affecting the consumption on an average of about 3 per cent. in a 100-kw machine, 4 per cent. in a 500-kw machine and 5 per cent. in a 1,500-kw machine, the effect being more at high vacua than at low. The maintenance of a good vacuum necessitates a suitable condenser, which implies sufficient tube area and also ample way for the steam between the tubes; proper velocity of water in the tubes; sufficient supply of cooling water and a sufficient means of cooling the condensed water so as to keep the air pump cool, and full provision for extracting by the air pump and other means the inevitable small quantity of air which must leak in.

It is stated that by attention to these requirements it is unnecessary to increase the size of the condenser beyond that used in ordinary practice. In the case of the most recent condensers for steam turbines, from 10 to 12 pounds of steam are condensed per square foot per hour, at which rate of condensation a vacuum may be obtained at from 27½ to 28 in. at full load. The amount of cooling water generally allowed is about 50 times the full load steam consumption, which will increase the vacuum under normal conditions by about ¾ in. or 1 in. over that obtained by the usual circulating allowance of 30 times the steam used. With a proper arrangement of pipes and condensers in a plant taking 18 pounds of steam per kw-hour and assuming 50 per cent. efficiency in the pump and motor, the power used by the circulating pump is only 1 per cent.; by circulating water 30 times the steam consumption it would be .6 per cent., which small reduction is not to be compared with the gain of 4 or 5 per cent. in the turbine by the use of increased circulating water.

The paper described a vacuum augmenter which has recently been introduced and which is illustrated in Fig. 3. A pipe is led from

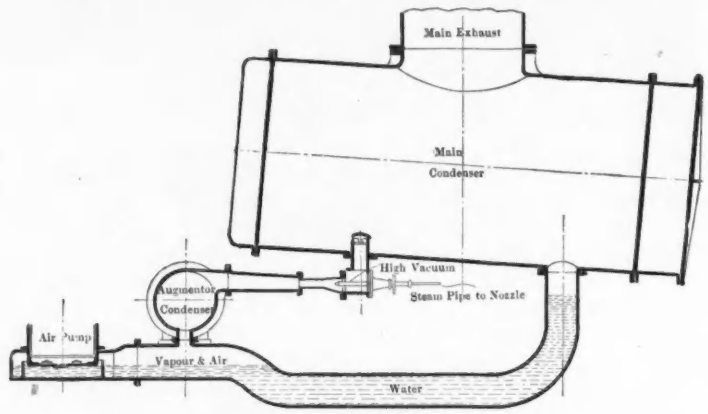


FIG. 3.—ARRANGEMENT OF VACUUM AUGMENTER.

near the bottom of the main condenser to an auxiliary condenser having generally about 1/20 the cooling surface of the main condenser. In a portion of this pipe a small steam jet is placed which acts in the same way as a steam exhauster and sucks nearly all the residual air and vapor from the condenser and delivers it to the air pumps. A water seal is provided, as shown, to prevent the air and vapor from returning to the condenser. With this arrangement, if there is a vacuum of 27½ or 28 in. in the condenser there may be only about 26 in. in the air pump, which, therefore, need only be of small size, the jet compressing the air and vapor from the condenser to about half or less of its original volume. The steam jet used only about 1½ per cent. of the quantity of steam used by the turbine at full load. Condensation takes place in the condenser much more rapidly and effectually if the air is thoroughly extracted.

In Fig. 2, which represents tests of the 1,500-kw plant at Sheffield, one curve was taken with and another without the vacuum augmenter in operation. The difference of vacuum is shown, and when it is remembered the augmenter jet took only about 1½ per cent. of the full load steam consumption, it is easily seen from the gain of vacuum where the total gain by the use of the augmenter comes in. In this case the vacuum was not as good as it should be, since the cooling water was at a temperature of 85° F., and was in volume only about 30 times the steam consumption at full load.

Referring to the design of dynamos and alternators to be coupled to steam turbines, it is stated that special regard is to be paid to the large centrifugal force to be encountered. Diameters have to be kept down, and excessive surface speed must also be avoided. Since then the diameter has to be small, the length must be increased in proportion and a long core is the result, with moderate diameter,

the contrary of slow-speed machines. At the same time, on account of the higher surface speed, the pitch of the poles is greater, thus

TESTS OF PARSONS TURBINES.

	Steam pressure at stop valve.	Superheat. F°.	Vacuum inches.	Speed, Revs. per minute.	Load in K.W.	Pounds steam per K.W.-hr.
75-kw Continuous-Current Turbo-Generator—Banbury.	141.2	84.2	27.1	4,140	75.7	26.4
	144	0	27.0	4,140	75.2	29.2
	142	0	27.1	4,140	56.6	31.2
135-kw Turbo-Generator—Findlay, Durham & Brodie.	150.8	99.0	27.15	3,600	138.3	22.8
	151.0	81.0	27.3	3,600	66.9	27.6
200-kw Continuous-Current Turbo-Generator—Shipley.	150	57	27	3,000	204.2	22.23
	151	55	27.9	3,000	101.2	26.67
	156	181	27.3	3,000	202.5	20.39
	151	166	28.0	3,000	100.27	24.41
375-kw Turbo-Generator—Dundee.	152.9	——	27.4	3,000	376.9	21.6
	149.4	148.9	27.5	3,000	374.06	19.25
350-kw Turbo-Generator—Pennsylvania Salt Co.	150	71.3	27.82	3,360	359.5	20.64
	152	65.7	28.27	3,151	185.5	23.44
	140.2	92.3	17.4	3,430	353.5	25.54
	143.4	82.5	17.4	3,255	177.2	32.26
300-kw Turbo-Generator — Hulton Colliery.	161.0	0	0	3,000	296.6	34.2
	158.0	0	15.33	3,000	297.4	29.36
	157.0	0	19.33	3,000	305.1	27.43
	152.0	0	22.33	3,000	303.4	25.59
	154.0	0	25.33	3,000	303.15	24.19
	158.0	0	26.58	3,000	303.2	23.15
300-kw Turbo-Generator—De Beers Explosives Works.	150.0	53.3	27.88	3,000	312.1	20.06
	153.0	50.0	27.78	3,000	231.8	21.45
	150.5	40.2	27.9	3,000	154.5	23.75
1,500-kw Turbo-Alternator—Newcastle-on-Tyne, E. S. Co.	196	76	27.45	1,200	1,442	18.0
	197	84	27.35	1,200	1,015.5	19.8
	196	76	27.95	1,200	714.0	21.4
	199	77	28.35	1,200	360.5	25.2
	200	68	28.45	1,200	——	——
After 16 months' use the following figures were obtained:	203	92	26.11	1,210	1,823	17.7
	207	66	26.46	1,208	1,513	18.23
1,500-kw Turbo-Generator—Sheffield Corporation. With Vacuum Augmentor and including 450 lbs. steam per hr. used by it.	113.6	108.3	26.69	1,455	1,316.5	18.75
	111.6	156.4	27.12	1,500	1,061.6	18.66
	141	113	27.72	1,500	512.7	22.3
	154	47.5	27.72	1,500	0	0
Without Vacuum Augmentor.	115.6	143	25.18	1,500	1,029.3	20.7
	137	119	25.97	1,500	534.25	24.02
	150.3	72.4	26.62	1,500	0	0
Non-Condensing Turbines. 250-kw Continuous Current—Messrs. Guinness, Son & Co.	144	0	0	3,047	251.55	37.80
	142.6	0	6	3,047	255.82	41.38
	138	0	11.1	3,055	253.15	44.15
	143	0	11.0	3,115	125.45	59.58
500-kw Turbo-Generator—Metropolitan E. S. Co.	142	0	0	1,800	506.2	33.39
	147	0	15.67	1,800	509.06	29.07
	144	0	18.57	1,800	514.9	28.33
	145	0	20.67	1,800	512.2	27.22
	146	0	22.57	1,800	509.85	26.89
	154	0	0	1,800	0	——
	151	0	26.1	1,800	0	——

giving more ampere-turns per pair of poles than is usual. In alternators this gives no trouble at all, as all that has to be provided is sufficiently strong field magnets to overcome the reaction of the armature, and sufficient magnetic resistance to allow of strong field magnets. This extra magnetic resistance can be given either in the air-gap or by saturation of the poles, as may be found desirable. These large poles also conduce to diminish magnetic leakage, and as a result very good regulation can be obtained.

In low-voltage alternators rotating armatures are preferable, as the iron and copper losses are much less, especially where there are only two or four poles, but rotating armatures, although satisfactory for 500 to 2,000 volts, have not been found suitable for the higher voltages of 6,000 and 10,000 which are now common, and therefore rotating fields and fixed armatures have been adopted in many of the recent alternators. For continuous-current dynamos the same remarks apply, only here sparkless commutation has to be provided for. Carbon brush blocks cannot be used, as at these speeds the brushes are apt to vibrate, and so diminish the intimacy of contact and cause heating and undue wear. The result is that it has been found best to form the brushes of wire, gauze or foil, preferably of brass, and these must be sufficiently flexible so as to maintain a good contact with the commutator over the whole section of the brush. It follows, therefore, that the properties of the carbon brush

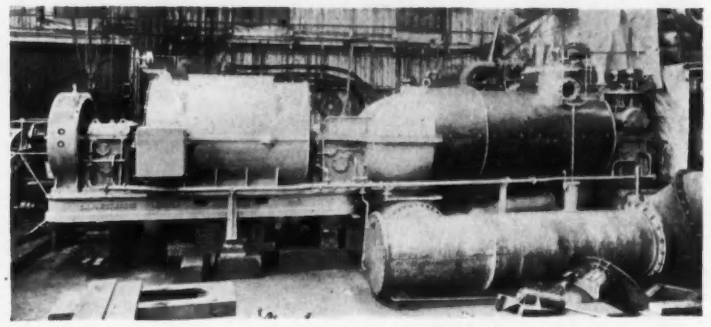


FIG. 5.—2,000-KW PARSONS TURBINE.

blocks in giving sparkless commutation without alteration of the lead of the brushes, cannot in turbine-driven dynamos be utilized, and other means must be adopted to secure sparkless commutation at varying loads. One way is to shift the brushes automatically according to the change of load, and this can be effected by connecting the brush gear to a steam cylinder controlled by a spring and supplied with steam from the point where the steam enters the turbine. At this point the pressure of the steam is proportional to the load of the dynamo, and therefore the piston in the steam cylinder being controlled by a spring takes up a position proportional to the load and thus shifts the brushes to the point of sparkless commutation. Another method is to provide commutating poles as proposed by Prof. Ryan and others, but the best method is to provide compensating winding as proposed by Prof. Forbes, Deri, etc. By these means, with the improvements recently adopted, absolutely sparkless commutation can be secured with fixed brushes, up to, in plants for traction purposes, 100 per cent. overload.

Mr. Parsons points out that the size of turbines is rapidly increasing, many of from 4,000 to 6,000-kw capacity now being in the course of construction, and it is anticipated that still larger plants will be made shortly. Up to the present there are about 600,000 hp of turbines of the Parsons type at work and on order in England and on the continent, in various sizes ranging up to 7,000 kw.

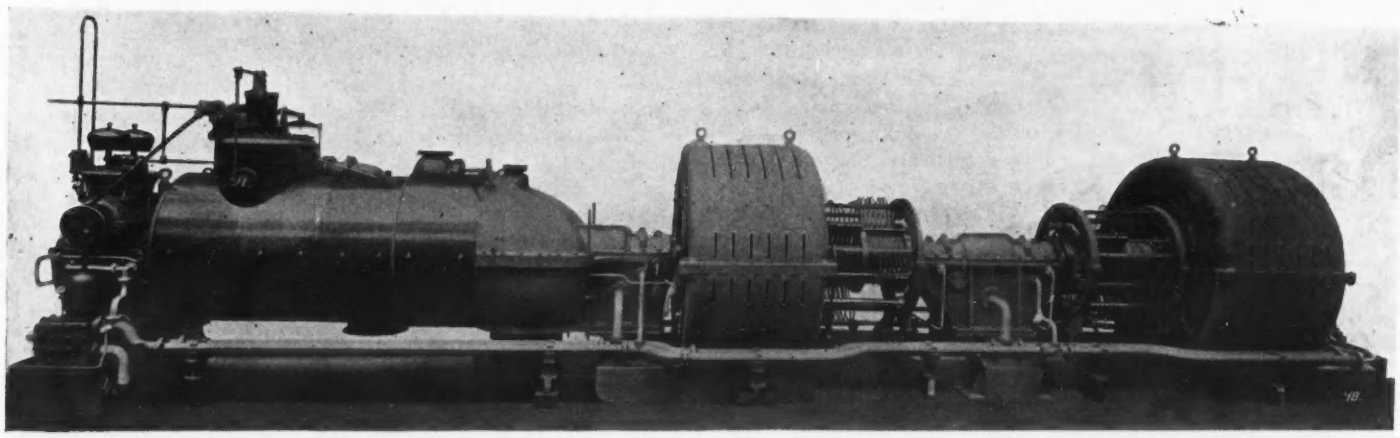


FIG. 4.—1,800-KW PARSONS TURBINE, MANCHESTER.

Electrical Interests at Panama.

A cable dispatch from Panama says that the electric light and tramway plants and telephone system in the Panama Canal zone have been bought by a syndicate in which American capital in interested.

Chicago Meeting of American Society of Mechanical Engineers.

The 49th meeting of the American Society of Mechanical Engineers, held at Chicago May 21 to June 3, was a joint meeting with the British Institution of Mechanical Engineers. The professional sessions were held in the evenings in the Music Hall of the Fine Arts Building and in the mornings in the Auditorium Hotel, with the exception of the last meeting, which was held on the morning of June 3 in the auditorium of Lewis Institute. The local committee had prepared for the use of members a pamphlet guide to points of interest in Chicago, and made very complete arrangement for the entertainment, both professional and social, for visiting members.

The meeting was opened on Tuesday evening by an address of welcome by Mayor Harrison, which was responded to by President Ambrose Swasey, of the American Society of Mechanical Engineers, and President J. Hartley Wicksteed, of the British Institution of Mechanical Engineers. The local committee carried out an elaborate programme for the entertainment of the ladies of the party, and half of each day was devoted to a visit to some point of professional interest in Chicago or vicinity. On Friday evening the local members of the American Society of Mechanical Engineers provided a special concert by the Thomas Orchestra in the Auditorium Hotel to visiting members of the American and British Societies.

Three of the papers on the programme were on the steam turbine, covering respectively the De Laval, Westinghouse-Parsons and Curtis types. The paper on the first-mentioned type was contributed by Messrs. E. S. Lee and E. Meden, the first part of which is devoted to a description in detail of the turbine. The applicability of this type of turbine for driving centrifugal pumps and blowers is pointed out. In both cases high velocities are required for good efficiencies, and with the De Laval turbine it is easy to produce the most suitable velocities. For lifts from 15 ft. to 150 ft. smaller turbines having one gear shaft may be employed, and for lifts of 40 to 300 ft. large turbines with gear shafts; for a greater lift the centrifugal pump has been directly connected to a high-speed turbine shaft, the pump wheel in this case revolving with a velocity of from 10,000 to 30,000 r.p.m. As the pump wheel in the latter case will naturally be very small and not produce any suction, it must be fed by another pump connected with the gear shaft running at a considerably reduced velocity. Pumps of this type have been made for lifts up to a normal head of 850 ft. on a single wheel and in some cases this type has been made for feeding boilers.

The Curtis turbine is represented by a paper contributed by Mr. W. L. R. Emmet. The claims for this type of turbine with respect to its rivals are treated at some length, and the paper contains a number of illustrations of the turbine as a whole and of some of its parts. It is stated that practically no troubles or interruptions have been caused by the step bearings, which have developed a ruggedness and stability far beyond the expectations of the designers. In newer designs, however, a powerful brake will be provided, bearing on the lower surface of a chilled iron ring carried by the lower wheel. This brake can be conveniently operated from the outside and can be used to take the whole weight of the revolving part in case the step bearing should fail. In ordinary operation the shoes of the brake will be set about .01 in. below the brake ring to be in position to receive the revolving part in case the step bearing part should fail. Another function of this brake is to stop the machine when it is desired to do so, and it is stated that one of the 5,000-kw vertical machines will run for four or five hours after the steam has been shut off unless load is put upon it or a brake is applied.

The data are given of the test of a 2,000-kw machine operating a 6,600-volt, 25-cycle generator in the General Electric Works at Schenectady at a speed of 750 r.p.m. With a load in kilowatts of 637 and a vacuum of 28.2, the consumption of steam was 20.1 pounds per kw-hour; with a load of 1,000 kw and a vacuum of 28.9 the consumption was 16.3 pounds; with a load of 2,000 kw and a vacuum of 28.3 in., the consumption was 15.3 pounds per kw-hour.

Mr. Francis Hodgkinson contributed a paper entitled "Some Theoretical and Practical Considerations in Steam Turbine Work," which related principally to the Westinghouse-Parsons type of turbine. The paper after a résume of the fundamental principles of the steam turbine, gives short descriptions of the several types of steam turbines now on the market, and then takes up the description in detail of the Westinghouse-Parsons type. The description, which is the best that has yet appeared of this type of turbine, enters largely into matters of direct practical interest. In explaining why three diameters of a barrel have been generally used in this type of turbine, it is said that this selection has no bearing whatsoever on the theory of the machine, but is merely one of mechanical convenience. The proper expansion can be provided for just as well should there be one or several different diameters. It will be found, however, that if a speed and diameter of a drum were selected that would permit convenient proportions of the blades of the outlet, the blades at the inlet of the turbine would become mechanically small; similarly, if diameters and speeds were selected to suit the inward blades, the areas of the blades in the last stages would become unmanageably large. Referring to the matter of leakage, it is pointed out that in order to avoid overestimating its probable extent, it is necessary to bear in mind a point which is usually lost sight of and which in a considerable measure offsets the loss from this source. This is that since in a machine of given size the radial clearances between the ends of the blades and the walls of the turbine are constant, the greater leakage naturally occurs at the high-pressure ends of the turbine or at the beginning of the expansion; and by the time the lower stages of the turbine have been reached, the total volume of the steam has become so great compared with the clerance area that the latter becomes unimportant. All leakage steam returns energy to the working steam in the form of heat, as its action is similar to wire drawing treating in a restricted opening. Hence, it is superheated in a slight degree and serves to partially dry the working steam, which contains considerable moisture due to adiabatic expansion.

Referring to the early Westinghouse-Parsons turbines of large size which were constructed in tandem, two-cylinder form, it is stated that the two objects of this construction were to reduce the span between bearings and to allow the use of a reheater between the high and low-pressure cylinders. Exhaustive tests have, however, shown that the reheater is of little or no value in increasing the economy of a turbine. Referring to the effect on economy of entrained moisture in the steam, it has been found that the steam consumption is increased to an amount about twice the percentage of moisture in the steam; that is to say, 2 per cent. of moisture will decrease the economy about 4 per cent. While in small sizes of turbines flexible bearings are used consisting of a nest of concentric bronze sleeves with sufficient clearance between them to permit the formation of oil films to act as cushions, such bearings have not been found necessary in the larger sizes of machines, or in fact for any machines running below 1,200 r.p.m. One of the recommendations of the steam turbine is that it makes possible the use of a still further type of electrical generator which, although possessing difficulties in design for adaptation to ordinary engine speed, becomes ideally suited for direct-connection to the turbine. The machine referred to is the induction generator; that is to say, the induction motor run as a generator. While its peculiar electrical characteristics impose limitation upon its general use in power station work, when employed in conjunction with synchronous apparatus such as between alternators, synchronous motors and rotary converters, it becomes peculiarly suitable for the extension of a power system in which the limit of generator capacity has already been reached. When used on a system to which synchronous motors are connected, by overexciting the fields of these latter, the effects can be neutralized of the magnetizing currents required by the induction motor. This is one of the few cases in which the electrical and mechanical conditions concerning generator and prime-mover are almost exactly suited to each other. In general the higher the speed at which the induction generator can be safely operated, the less the material necessary and the smaller the losses, resulting in an extraordinary efficiency and power factor. For example, with a two-pole, 60-cycle induction generator of 500 kw, running at 3,600 r.p.m., the power factor may be brought as high as 98 per cent. or higher at full load, and the total efficiency will be far greater than that of present generating machinery. The paper concludes with an account of tests of Westinghouse-Parsons turbines and information relating to foundations and power plant designs.

Mr. Lionel S. Marshall, of Cambridge, Mass., contributed an interesting paper entitled "The Use of Superheated Steam and Reheaters of Compound Engines of Large Size." This gives the result of a number of tests made during the past five years on several high-speed, two-cylinder compound engines, all built by the same makers and all of the same type. The investigations were made to determine the economy of the engines under different loads both with and

without jacketing and reheating. The paper contains reproductions of almost two-score curve sheets and gives the details of the various tests together with their data. The conclusions are that in the case of large size high-speed compound four-valve engines of common proportions, the jacketing of the high-pressure cylinder is of but little avail when moderately superheated steam (100° F. is used). Reheaters are probably a source of loss unless they superheat the receiver steam at least 30° F., and is not fully effective unless it superheats 100° F. Jacketing the low-pressure cylinder is shown to be unnecessary by reference to the steam qualities during expansion in that cylinder, and, therefore, undesirable when the reheating is effective. The effect of admitting moderately superheated steam to both the high-pressure and low-pressure cylinders is to keep the heat consumption per indicated horse-power practically constant throughout a considerable range of loads—from half load to about one-fourth overload.

Mr. William P. Flint, in a paper entitled "Commercial Gas Engine Testing and a Proposed Standard of Comparison," advocates the determination of the available or brake horse-power and not the indicated horse-power, and a basis of comparison depending upon the suction displacement per minute. It is stated that the results of tests of a large number of gas engines using natural gas for fuel have shown that every 345 cu. ft. of suction displacement per minute will give in the neighborhood of 115 maximum brake hp or 100 effective brake hp. Knowing the diameter of cylinder, the stroke, the test speed and the number of charges possible per double revolution, the suction displacement per minute is simply calculated. The result in cubic feet when used as a numerator of a fraction of which 345 is the denominator, gives what is called a reduction factor. Then, having the brake horse-power and the British thermal units of any given test, if these be multiplied by the reduction factor found as above, the result will be the brake horse-power and the British thermal units on a 100-hp basis. By applying in this manner the results of a large number of tests of gas engines, the manufacturer can ascertain the characteristic British thermal units per brake horse-power curve for each size and type, and from these can predict what new sizes should do. Besides enabling an average performance curve to be located with considerable certainty, this 100-hp basis method also lends itself well to the determination of limiting curves between which the performance of any engine may be expected to fall. This is often found very useful in drawing attention to defects in an individual engine and in detecting errors which occasionally may be made in shop tests.

In a paper entitled "The Potential Efficiency of Prime-Movers," Mr. C. V. Kerr designates by this term in the case of water wheels, the ratio between 550 × the brake horse-power developed, and 62.3 × the flow in cubic feet per second × the head in feet; and in the case of steam engines, the ratio of the heat equivalent of a horse-power or 2,545, and the weight of steam per horse-power-hour × the difference between the initial and final total heat in the steam. Tables are included giving the potential efficiency of a large number of types of water wheels and steam engines. In the case of water wheels this efficiency ranges from 68.3 per cent. to 86.8 per cent. in the case of turbine wheels, and from 81 to 91 per cent. in the case of reaction wheels. In the case of reciprocating steam engines, the efficiencies thus calculated from authoritative tests are with few exceptions above 60 per cent., and going as high as 80.5 per cent. in the case of a Schmidt engine tested at Pabienice, Poland, and to 80.2 per cent. in the case of a Snow pumping engine at Indianapolis. For steam turbines the potential efficiency thus determined is considerably lower than for the steam engine, in only two cases going above 70 per cent.; one of these cases being the test of a Westinghouse 1,000-kw unit giving 70.8 per cent., and a Brown-Boveri-Parsons turbo-alternator giving 71.8 per cent. It would appear, however, that in the case of the steam turbine the efficiency is the combined efficiency of the turbine and generator.

Dr. Pupin Before the New York Electrical Society.

The 243d meeting of the Society was held at Havemeyer Hall, Columbia University, May 25. The secretary read the following statement: "On the first of June last year a special meeting was held for the purpose of considering and discussing the revision of the constitution and by-laws of the Society, which had been adopted by the executive committee for report to the 243d meeting of the Society. At that special meeting certain amendments were passed. The legality of the action of this meeting in so passing these amendments was subsequently called into question, and in order to determine its validity the executive committee empowered the president to secure legal advice on the point. I have here the opinion on the same duly rendered by Parker & Aaron. The document, which is somewhat lengthy for present reading, advised the president of the Society that the action of the special meeting in question was not legal, and that he, the president, must not recognize any validity as attached to the attempted amendments. This opinion was submitted to the executive committee at its March 31 meeting, and duly approved and formally adopted by the committee. On the direction of the executive committee, the president subsequently appointed as a committee to revise the constitution and by-laws of the Society three of its past presidents, Francis W. Jones, Gano S. Dunn and Arthur Williams. The report of this committee was duly submitted to the executive committee and approved and adopted by it at its meeting of April 26. The revision, as recommended by the committee and as approved by the executive committee, will now be submitted to the Society. The further action necessary in this case is that this revised edition of the constitution and by-laws shall be further submitted to the Society at its next meeting, at which it shall require a two-thirds vote for its adoption." The revision of the constitution and by-laws, as submitted by the revision committee to the executive committee, and approved by the executive committee, was then read.

The subject of the evening was "Selective Signaling by Electrical Resonance." Dr. M. I. Pupin explained that he had originally intended, according to promise, to lecture to the Society on the "Physics of Wireless Telegraphy," but, owing to absence in Europe and lack of time, he had been unable to prepare an adequate lecture on that subject. The present subject, however, was closely identified with many of the phases of wireless telegraphy, which he had intended to treat in the lecture first proposed. Dr. Pupin proceeded to explain the principles and essential elements of the system of transmission by electrical resonance, classifying these elements as the multi-frequency alternator, the transmitter, the distributors, the resonators and the rectifiers. As described by Dr. Pupin, the alternating-current generator consists of six fields and six armatures, mounted on the same shaft. The various fields and armatures differ from each other in the number of poles. The number of poles is 4, 6, 10, 16, 24 or 34, giving frequencies of from 60 to 512. The various e.m.f's generated by these machines are impressed upon the line by tuned transmitters. At the receiving end there are branch circuits in parallel with each other, each branch consisting of a coiled condenser, so adjusted that the branch will offer a minimum impedance to one of the six frequencies transmitted. In inductive relation with these distributors are local resonators tuned electrically to respond to one of the six frequencies. Each resonator works upon a local relay circuit, this circuit consisting of a relay constructed like a Weston direct-current voltmeter. In series with the relay is a polarization cell, consisting of platinum electrodes in dilute sulphuric acid. In series with the relay is a rectifying polarization cell described by Dr. Pupin in several publications, and patented within the last few years. The polarization cell enables the alternating current to actuate the direct-current relay.

At the special request of the United States Patent Office Commissioner, Dr. Pupin has prepared an exhibit for the United States Patent Office, at the St. Louis Exposition, illustrating the transmission of telegraphic messages by alternating currents of various frequencies, the receiving and transmitting apparatus being electrically tuned to the frequencies, which they are intended to receive and transmit. This exhibit was shown at the lecture, but much to Dr. Pupin's disappointment it was not in working order, owing to an accident which had occurred during the afternoon. The polarization cell anodes had been covered with platinum black and this defect was not discovered until some time after the lecture.

The annual meeting of the Society is to be held in June at the Lamp Testing Bureau, Eightieth Street and East End Avenue, when the regular business of the occasion will be supplemented by some interesting features. A large attendance is expected.

New Telephone Patents.

EXCHANGE SYSTEM.

Just as two-wire common battery switchboards have superseded the three-wire boards in some localities, in the attempt to successfully bring the maximum number of subscribers' lines within the reach of an operator, so is it natural that a one-wire wiring scheme for multiple jacks should be brought forward as a further step in the same direction. At first sight the difficulties to be overcome in designing circuits for such a switchboard seem almost insignificant; but to devise a system to meet the demands of modern operating methods is no mean problem, first because of difficulty in obtaining the desired signals for supervision, and second because of the difficulty of balancing such a system. The first of these difficulties seems to have been rather simply overcome by Mr. C. E. Scribner in a system described in a patent just issued to him and assigned to the Western Electric Company. All relays are associated directly with the various subscriber's lines, the cord circuit containing no signaling apparatus except the ringing keys and supervisory lamps, these latter being included in the talking circuit. Herein would seem to lie a serious disadvantage from the "talking" standpoint, because of the introduction of the lamp terminals into a part of the talking circuit carrying continuous current. This, coupled with cross-talk difficulties, will probably render the system in its present form valueless from a practical standpoint.

LIGHTNING ARRESTER.

In Fig. 1 is shown a very compact and neat arrangement of fuse and open-space cut-out for combined use as a lightning arrester. It

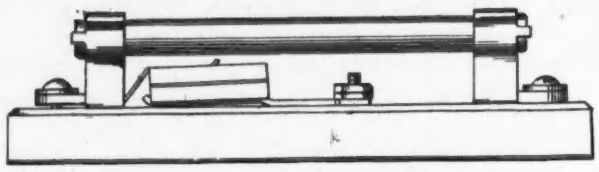


FIG. 1.—BARCLAY LIGHTNING ARRESTER.

is the idea of the inventor, Mr. J. C. Barclay, of New York City, to bring these two devices into as small a space as practicable and yet have either removable for inspection without disturbing the other, and he has certainly succeeded admirably.

SELECTIVE SYSTEM.

Messrs. F. C. Penfield and O. Templin have recently patented a selective system adapted for independently ringing up to ten parties upon a single line. The system depends upon the point use of both sides of the line and the ground in various combinations with relays and selective bells and several sources of current. At two of the stations both relays and bells are responsive to alternating currents, the selection of one of these stations being dependent upon the application of such current to one side of the line only. At these stations the relays are arranged to open the bell circuits when energized, and each is wired through a condenser to ground from the side of the line other than that from which its bell is wired. There-

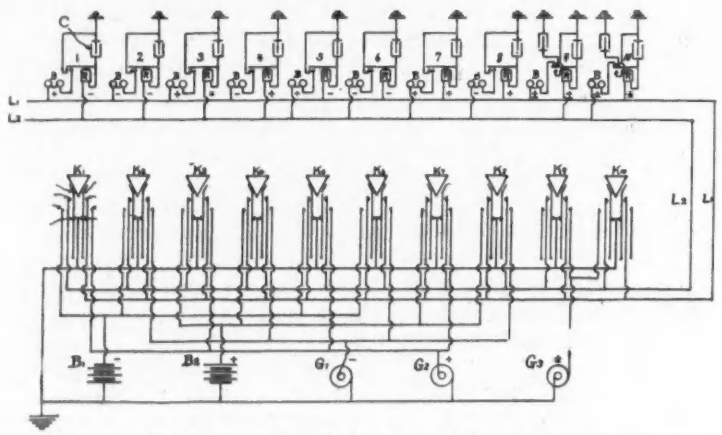


FIG. 2.—PENFIELD AND TEMPLIN SELECTIVE SIGNAL SYSTEM.

fore, when the relay is operated the bell cannot be. For every other station the bells are normally upon open circuit, being grounded only by the actuation of the corresponding relay. Both relays and bells at these stations are polarized and the latter are biased to respond to impulse currents of one sign only. For these stations the relay is normally grounded through a condenser, but it is found that the charging of this latter is sufficient to cause the relay armature to respond sufficiently to automatically short-circuit the condenser as long as the actuating current is maintained. Fig. 2 shows diagrammatically the circuit of this system, the signs indicating clearly the current combinations necessary for the different stations.

AUTOMATIC SYSTEM.

Several years since an automatic exchange system was patented by J. C. Slater, of St. Louis, for which an improvement now appears. The system referred to requires the subscriber calling to insert a pin in a socket corresponding to the desired number, and then to release a rotating arm which, under the influence of a motor, proceeds synchronously with a central office switch arm. Upon the completion of the connection it is necessary to withdraw the above-mentioned plug to restore the apparatus to normal, and it is the subscriber's failure to do this which has led to the present improvement. With the modified apparatus, if the receiver be returned to the hook and the plug not withdrawn, an auxiliary signal bell notifies the subscriber of his error.

CIRCUIT CHANGER.

Under this title a method of bending springs for switchboard keys or hook switch elements has been patented. The peculiarity of these springs is that the flaring of the end is about a line diagonal to the length of the spring, the inclination of this line with the edge of the spring being such as to correspond with the angle from which the actuating plunger approaches. C. C. Cadden, of Cleveland, Ohio, is the inventor, the Williams Abbot Electric Company obtaining the patent by assignment.

Trolley and Steam Developments in New England.

It is stated, from New England sources, that trolley competition, which has seriously affected the profits of steam roads in Central New England, will be met by a reduction of fares by the Boston & Maine Railroad, which is paralleled by trolley roads between Springfield and Greenfield, a distance of 40 miles. The New York, New Haven & Hartford Railroad and the Boston & Albany division of the New York Central Railroad, which are affected by trolley competition, are also considering similar measures.

The schedule of fares which will go into effect on the Connecticut River Division of the Boston & Maine Railroad is in every instance as low as the trolley rates. The railroad has suffiered especially heavy loss in local traffic between Springfield and Northampton. Under the new schedule the fare from Springfield to Holyoke, a distance of nine miles, will be reduced from 15 to 10 cents. Between Northampton and Springfield, 18 miles, the fare will be cut from 33 cents to 20. From Springfield to Greenfield the rate will be 50 cents instead of 83. Reductions will be made in about twenty instances. The road provides frequent service, and expects to regain traffic which patronizes the trolleys for economical reasons.

The railroad officials believe that the saving in time and the more comfortable accommodations which steam cars afford in stormy weather will result in a return of the public to the steam cars except for short distances. The action of the railroad comes as an entire surprise. Electric road officials admit that the reduction will hurt their business, as they have no way of checkmating the new schedule except by concessions which would eliminate profits.

The New York, New Haven & Hartford Railroad, which has met trolley competition in parts of Connecticut by obtaining control of the trolley lines, will, it is authoritatively stated, adopt a different method to regain traffic between Hartford and Springfield. The road runs but few trains between the two cities over the Highland and Central New England divisions. These routes, it is said, will be equipped with the third-rail system and cars run at frequent intervals. The fare will be the same as by trolley, with the advantage of greater speed.

The Consolidated Railway Company—the corporate name of the new combination of trolley roads controlled by the New York, New Haven & Hartford Railroad, and including the Fair Haven & Westville, of New Haven; the Worcester & Connecticut Eastern, and the Meriden Electric Railroad—has just been formally organized. Officers were chosen as follows: President, C. S. Mellen; first vice-president, E. H. McHenry; second vice-president, H. M. Kochersperger; secretary, J. G. Parker; treasurer, A. S. May; assistant treasurer, T. F. Paradise.

CURRENT NEWS AND NOTES.

HARD TO GET ELECTRICIANS.—The artillery corps of the Army is, according to the New York *Tribune*, having great difficulty in obtaining master electricians. The place has existed for a year or more, and the War Department has been able to appoint only six who are in all respects qualified. Six others are being trained in the practical discharge of the duties of the place at Fort Totten, N. Y., preliminary to final appointment, but no one has any idea where the remaining thirteen master electricians are to come from. These men receive $75 a month, the highest pay of any of the enlisted force of the military establishment. Their duties are technical, and, as is indicated by the title of the place, relate to electricity in the coast forts. It was expected that civilians would be induced to come into the army, but the restrictions of military life do not seem to attract good electricians from that quarter. So far only two appointments have been made from civil life.

ANOTHER DANGER FROM ELECTRICITY.—The New York *Sun* prints a letter from a Mr. J. S. Daggett, of Saratoga, who brings a new charge against electricity. There are, he says, irrefutable facts at hand proving that the use of electricity has caused during the past fifteen years a greater loss of property by fire, flood, storm and unseasonable weather than the value of ten railroads like the New York Central. "Are our farmers along the northern Atlantic slope to be ruined? Have we an Agricultural Bureau? So intense was the cold during the past winter that the ground was frozen six feet deep. In digging graves gunpowder was used for blasting out. Millions of fruit trees have been killed. Science says that you cannot use electricity as we do without affecting the air, weather and climate. Must the people suffer to gratify the stupidity of certain corporations? A gentleman has just informed me that his orchard of fine trees has been ruined. The roots of the trees are as dead as though burned by fire. New England and New York State did not receive the tenth of a crop of yellow Indian corn last year. The Government should prevent the use of electricity on such a scale as is proposed by the New York Central now. What are the interests of all the railroads and all the manufacturing electricians as compared with the agricultural interests?" Unfortunately, Mr. Daggett does not set forth the "irrefutable facts," nor does he favor us with the source of his scientific inspiration—which would be interesting.

HIGH-SPEED CENTRIFUGAL PUMPS.—Prof. J. E. Denton and Mr. William Kent have recently made some exhaustive tests of a type of centrifugal pump made by the De Laval Steam Turbine Company, especially designed for use with De Laval steam turbines. Three pumps were tested as follows: 1. A single-stage centrifugal pump designed for delivery of 1,700 gallons per minute and a lift of 100 ft. when running at 1,545 r.p.m. This pump was direct-connected to the geared shaft of a 55-hp De Laval steam turbine. 2. A single-stage pump direct-connected to a 20-hp direct-current electric motor, designed for 1,200 gallons per minute against a lift of 45 ft. and at 2,000 r.p.m. 3. A two-stage pump designed for a delivery of 250 gallons at 700 ft. head; the large pump being driven at a speed of 2,205 r.p.m. by direct-connection to the geared shaft of a De Laval steam turbine, and the small pump driven at 20,500 r.p.m. by direct-connection with a high-speed shaft of the engine. The object of the tests was to determine the efficiency of the pumps. The efficiency of the first-mentioned pump was found to range from 74.3 to 75.6 per cent. for delivery between 1,398 and 1,860 gallons per minute, the efficiency representing the ratio of the water horse-power of the pumps to the brake horse-power of the driving motor. The steam per hour brake horse-power running condensing ranged from 24.06 to 20.53 pounds for these deliveries. The test of the electric motor-driven pump showed an efficiency of 71.4 per cent. for a maximum delivery of 1,403 gallons per minute to 75 per cent. for a delivery of 1,133 gallons, falling down to 68.3 per cent. for a maximum delivery of 790 gallons per minute at the highest heat of 59 ft. With throttle suction there was a decreased efficiency of only 2 per cent. The two-stage compound pump showed a consumption of steam per water horse-power-hour ranging from 40.5 pounds for the maximum horse-power and highest head to 106.2 pounds for the maximum delivery, lowest head and lowest horse-power.

LETTER TO THE EDITORS.

The Inventor's Point of View.

To the Editors of Electrical World and Engineer:

SIRS:—The rule in some foreign countries (but not in our kindred Great Britain) requiring the manufacture of an invention within a fixed limit of time is one of the greatest evils ever invented by a government. Former Commissioner of Patents Seymour has eloquently represented this disadvantage, and so have one or two others in reply to your editorial, which was valuable because of the vigorous discussion it is provoking and because of the new way of looking at the subject it brought forward. Besides, the majority may have agreed with you as far as I know.

The rule of three settles the whole question, I think. An invention is either ahead of time or just on time, or a little late. If the first the public will not accept it until they want it. To require manufacture before the public wants it, would be a severe penalty instead of an honor and reward for the inventor. The phonograph is an illustration. The broad patent became seventeen years old and therefore died a natural death before it was used as a popular substitute for the music box. The profits have come in to all except the inventor since the patent expired. Consequently, it is a punishment, financially and morally, to require "working" of inventions in advance of their day or to require several years to perfect sufficiently to be accepted by the public.

Secondly, if the invention "takes" from the start, the working requirement is useless. So also if the invention comes too late, as do many of the bicycle patents that would have brought big prices when the bicycle was popular.

Another manner of viewing the subject is to consider, as the law does, that seventeen years have been decided as a fair limit in absolutely every patent without exception. Now, if a thousand inventors have been thus rewarded, it is nobody's business whether they make $50,000 during the whole period gradually or during the first year, and none afterward, or during the last year and none before. The inventor who made the profit the first year would not be punished by the "working" requirement, whereas the other inventor would have lost his chance. In other words, the requirement would be an evil, because it would be unjust, and that argument points to the fundamental principle of the United States Government—justice to all alike. France and Germany are more arbitrary. It is so often beyond the power of an inventor to create a market for his invention that it would be cruel to try to force him to equip a $10,000 plant and manufacture and offer for sale a device which he knows is not wanted. However, it is possible for him to pay a nominal tax to test his faith in its probable future success, and this tax at the end of the fourth year, as in Great Britain, would not be very objectionable, but yet it would interfere with strict justice. Why should any citizen pay a tax on property that may not at the present amount to ten cents worth, and yet in the course of a few years may sell at sight for a small or large fortune. All real estate is taxed at a small per cent. of what it would bring at the time. All land will sell for something at an auction. Not so with all patents at any one date.

NEW YORK. EDWARD P. THOMPSON.

[Our correspondent appears to lose sight of the fact that a patent monopoly is not granted as a personal reward, but indirectly to encourage national prosperity by directly encouraging invention. Any public monopoly is in itself an evil, to which principle a patent monopoly is not an exception; but balancing good against evil experience in the past has shown that as a rule the good predominates in this particular kind of monopoly, thereby justifying the burden which its erection and enforcement lays on the public. To keep the balance, however, necessitates minimizing the evil; and while rules for safeguarding the public at times may bear hardly on individual inventors, it must be recognized that the other party to the compact—in our country, the sovereign people—have a right to condition its gift of monopoly. Any advantage taken of the monopoly granted which perverts its intention, that is—a final gain to the public—is an

evil that calls for suppression even though injury thereby be inflicted in exceptional cases. Unworked patents block the way of development along the lines they cover, and in the case of further and valuable invention along these lines, the original patentee can come forward and appropriate from the later inventor the fruits of his labor. But the greatest abuse in this connection is in the steady growth of the "paper" and "defensive" patent practice, which violates the fundamental principles justifying the grant of a patent monopoly, since the existence of such patents acts to restrict invention and places on the public a burden with no mitigating advantages to justify its imposition. Undoubtedly, when introducing into the constitution the principle of the patent monopoly, and subsequently in patent legislation, the lawgivers have had uppermost in mind the inventive genius represented by Watt as a type on the one hand, and on the other hand the devoted investigator and ingenious shop worker; and to-day we venture to say that the great mass of the American public consider that our patent system is erected and maintained for the encouragement of these types. In point of fact, however, except in the case of some great fundamental invention, the isolated, typical inventor is yearly becoming placed at greater and greater disadvantage, both within the Patent Office, where he has to meet "defensive" patents and "feeler" applications, and subsequently owing to the narrowing of the market for the patents of "outside" inventors.—EDS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Vertical Motor-Generator Groups.—A fully illustrated description of six motor-generators installed for an Austrian aluminum company. Their axles are arranged vertically, the commutators being about 5 ft. above the ground. The reason for this arrangement is that the various direct-current generators installed by the same company are also arranged with vertical axles coupled to vertical turbines. The attendants are well acquainted with this arrangement, which has proven very satisfactory since the care of the brushes is simpler and easier. The motors are built for 1,000 hp at a voltage of 1,000 and a frequency of 45, while the direct-current generators give 560 kw at 160 volts. The cast-iron magnetic field of every direct-current generator rests on the ground and on it the armature of the three-phase motor is directly placed. The two rotors are directly connected together. The dimensions of the machine are given with some curves of tests and detailed drawings.—*Zeit. f. Elek.*, March; (Potsdam), April 16.

REFERENCES.

Construction of a Three-Phase Synchronizer.—PERCY.—An article with dimension drawings on a useful synchronism indicator which may be produced by properly combining two small transformers, three incandescent lamps and a set of connecting lugs and sockets of the type commonly used for connecting up synchronizing lamps. One of the transformers must be three-phase and the other single-phase. The outfit is described in detail.—*Am. Elec.*, May.

Magnetic Stray Fields in Induction Motors.—GUILBERT.—The first part of a long mathematical article with reference to a recent paper of Behn-Eschenburg, on this subject.—*L'Eclairage Elec.*, May 13.

LIGHTS AND LIGHTING.

Street Lighting by Nernst Lamps.—JOSEPH.—An article in which the author endeavors to show that under favorable conditions, with the use of Nernst lamps, it is possible to produce a better light than that given by incandescent gas mantles, at a smaller annual cost per lamp than is charged in most towns for gas lighting, and still show a small net profit, which, together with the improved load factor, will show a marked increase in the profits of the undertaking. He first endeavors to "slay the frequent renewals bogey," and then gives tables of cost.—Lond. *Elec. Rev.*, May 13.

Arc Between Mercury and Carbon.—CASSUDO.—An account of tests of an arc between mercury and carbon. For the same current and the same distance of the electrodes, the voltage at the electrodes of the arc is greater if mercury is cathode and carbon anode, than if mercury is anode. The sum of the anode drop of voltage and the cathode drop of voltage is about the same for both directions of the current, but the drop in the column of the arc is greater if mercury is cathode than if it is anode.—*Phys. Zeit.*, May 15.

POWER.

Electrically-Driven Rolling Mills.—KÖTTGEN.—A long paper illustrated by diagrams in which the author first discusses merchant mills. Small mills, with motors from 300 to 600 hp, have been in operation for several years, and that they have given satisfaction is evinced by the fact that five larger mills requiring from 1,000 up to 1,500 hp are now being arranged for electric driving. Motors for mill driving must be susceptible to two kinds of regulation: first, it must be possible to set them for a normal speed, acording to the desired circumferential speed of the rolls; secondly, they must slow down considerably as the load increases, in order that the energy stored in the fly-wheel may be utilized. This regulation is accomplished by various means. With direct current a compound winding is provided and the regulation is effected without any appreciable loss of efficiency. On the other hand, with alternating current it is necessary to introduce resistance in the armature; this is a course of loss which, however, remains comparatively small until the speed is materially reduced. The economy of such a motor depends upon the duration of the decreased speed. The problem of balancing the power needed is of great importance, in order that both dynamo and motor may be protected, and it is usually solved by heavy fly-wheels. The use of a motor-generator makes possible a simple method of regulating the speed of the mill by coupling direct to the shaft of the same a generator for each and every driving motor and raising or lowering its voltage by the shunt. This also obviates the necessity for a starter, as the driving motors can be started by lowering the voltage in the primaries. In most cases the use of either fly-wheel or battery will be unnecessary. The author then compares the relative advantages of electric driving and the use of gas engines coupled direct to the mill. The introduction of electric transmission from the power station (which is equipped with gas engines) will add to the first cost, but on the other hand larger and, therefore, less expensive engine units are used; moreover, since all mills will not be using their maximum power simultaneously, the capacity of the power house can be measured by the average of the power needed. Another great advantage is the facility which motor driving offers for measurement of the power used, affording a continuous control, not only over the condition of the mill, but also over the roll design. This will tend to a lower consumption of power and an improvement in quality of the product. He then discusses the electric driving or roll tables and finally takes up the subject of reversing mills. In designing the electric drive for a blooming mill there are two important points: first, the mechanism to be employed for starting and stopping, since reversing gears cannot be used for such powers; secondly, the balancing of the variations in load since variations which may exceed 6,000 hp cannot be carried by the generating station. Both problems are satisfactorily solved by Ilgner's system, hitherto mainly used for mine-hoisting engines. It consists of installing between generating station and motor a motor-generator set coupled to a very heavy fly-wheel. The dynamo of the set is always built for direct current and the mill is driven direct from the latter, and by simply regulating the small shunt current the voltage of the so-called starting dynamo is raised or lowered. If it is raised the speed of the mill motor increases; if lowered, electric breaking takes place because the motor is forced to decrease its speed, and thereby transmit energy through the dynamo into the attached fly-wheel. This interposed motor-generator not only obviates the necessity of a starting resistance and permits electric braking, but also keeps the large variations in load in the secondary system away from the primary station and circuits. Variations in load are carried by the fly-wheel.—*Iron Age*, May 19.

Power Station Design.—MERZ AND MCLELLAN.—The conclusion

of their paper on power station design. They deal with the switch gear and emphasize that, on account of the absolute crippling of the power station which takes place, if there be any serious failure of the switch gear, it is justifiable to take every protection even at the expense of capital expenditure. Oil switches are essential and all high-tension circuits should be broken in this way—if only for the reason that opening the circuit under oil puts so much less stress on the cables and on insulation generally. The switch chosen should be capable of breaking any current which may be met with in practice. This practically means, in emergency, breaking the whole short-circuit capacity of the station. One of the greatest dangers to reliability of supply is the excessive carelessness with which cables connecting machines or feeders to the switchboard have in the past been cramped together indiscriminately in a trench or tunnel. In the case of a power station it is unsafe to allow cables carrying large powers, whether high or low-tension, even spaced some inches apart in tunnels or manholes, unless each cable is in its own duct or in some other way protected from the properly earthed metal shield. All instruments should be worked through transformers. Automatic overload devices should be installed so as to operate the switches on each outgoing feeder. The automatic adjustable circuit-breakers should have a time lag inversely proportional to the magnitude of the overload. The authors add some remarks on measuring apparatus and records and urge that complete permanent apparatus should be provided for the taking of necessary tests, thus avoiding the unreliability and uncertainty of make-shift arrangements.—Lond. *Elec.*, May 13.

Superheated Steam.—SMITH.—An article on the thermal effect and the practical utility of superheated steam. He endeavors to show that its utility has no reason beyond that of keeping the engine cylinder walls, piston surfaces and valve seats and faces dry. This dryness is of immense utility. While superheating gives a thermodynamic advantage beyond the maintenance of dryness, yet it is so very slight as not at all to compensate the expense of the process. The practical conclusion is that superheating should be carried only to that degree sufficient to insure dryness.—Lond. *Elec. Rev.*, May 13.

British Power Station.—A fully illustrated description of the Central Electric Supply Company's power station which supplies current "in bulk" to the Westminster electric supply corporation and St. James & Pall Mall Electric Light Company. The three-phase system has been adopted at 6,000 volts with a frequency of 46. The output last year was over 2,600,000 kw-hours. The price charged was 6 cents per unit, and a much lower price will be charged during the current year. The most striking features of the station are the use of Climax boilers only, without economizers, and the absence of condensers and superheaters.—Lond. *Elec. Rev.*, May 6 and 13.

Cheap Supply "in Bulk."—The Hull municipal electric plant intends to offer to the Northeastern Railway for lighting and power purposes 1,000,000 kw-hours per year at 2½ cents per kw-hour on a basis of a 27 per cent. load factor. This figure of 2½ cents will be liable to an increment or decrement of ⅛ cent for each three per cent. decrease or increase in load factor.—Lond. *Elec.*, May 13.

REFERENCES.

Steam Engine Speed Regulation.—MCGUIRE.—An illustrated article treating of the perquisites of engine governors. After briefly explaining the general purposes which a governor is required to subserve, the author enumerates the advantages and disadvantages of the two principal classes, namely, those that throttle the steam and those that vary the point of cut off.—*Am. Elec.*, May.

The Zeuner Valve Diagram.—MAJOR.—An illustrrated description of the Zeuner valve diagram and explaining its utility in solving problems relating to valve gears.—*Am. Elec.*, May.

TRACTION.

Mountain Railroad.—ARMKNECHT.—The first part of an illustrated article of the mountain road to Hohensyburg in Westphalia, Germany. It is partly an adhesion road and partly a cable road. The length of the latter is 445 meters and the gauge one meter, the difference of level being 93 meters. While one car is going down, another is going up. The greatest tension in the cable occurs when the car going upwards and filled with passengers enters the heaviest grade. The greatest power is required from the motor when at the same time the car going downwards is on the place of smallest grade and carries no passengers. The greatest tension of the cable is 2,929 kg. For operating the cable two motors are provided, one of which is in action while the other is used as reserve. Both motors have a capacity of 72 hp and are shunt-wound, direct-current motors running at 390 to 410 revolutions at a voltage of 500 volts. The connections of the motors are shown in Fig. 1. In order to start one of the motors the switch, *J*, is closed by hand and the rheostat, *R* and R^1, are adjusted. Their levers are mechanically connected in such a way that the resistances of the armature circuit are not dis-

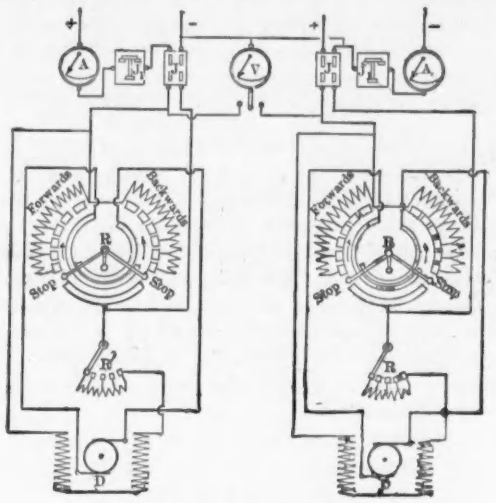


FIG. 1.—MOTOR CONNECTIONS.

connected before the exciting circuit has been closed. The attendant is thus able to send current into the armature only after the normal intensity of the magnetic field has been reached. The direction of rotation is determined by revolving the lever to the left or the right. In the circuit of each motor an automatic circuit-breaker, J_1, is inserted which is set into operation as soon as the current reaches a dangerous value. It is thus prevented that the current in the armature can get a dangerously high value, when the brake is actuated before the motor is disconnected.—*Elek. Zeit.*, May 12.

Interurban Railway Operation.—HERRICK.—A discussion of the new problems that have been brought on by the development of interurban lines from city systems. The author believes that the trolley is ill suited for heavy current collection at high speeds and that considerable improvement is possible in the present third-rail system. He suggests that the collector shoes be placed on the roof of the car and current collected from a light third rail placed on supports at a height of 2.5 meters above the surface of the road and far enough on the side to prevent accidents to passengers. He also states that the wires used on interurban cars are generally too small, as they are usually figured on the mean current taken by the motors, and that much trouble with motors and controllers is due to the fact that the voltage on the line near sub-stations is sometimes as high as 700 to 780 volts, whereas the equipment is designed for a 550 to 650-volt service. After taking up the question of multiple-unit control, distribution of feeders, and the danger of placing curves at the bottom of heavy grades, the author refers to electromagnetic signal systems and states that while ideal in theory they do not work out so well in practice, the reason being that the speed at which these magnets are required to work does not allow sufficient time to saturate the armatures, and if wound to operate when the car is running at a certain high speed they will be burned out if the same energy is applied if the car should happen to stand over a signal point. He suggests that where two trolley wires are used, each insulated from the other, a system of cut-outs can be devised so that when the car is taking current from one trolley wire the connection between the other and the feeder will be open, thus making head-on collisions between signaling points impossible.—*St. R'y Jour.*, May 21.

Rail Bonding.—SHEARDOWN.—The conclusion of his paper on tramway rails and rail bonding. He considers that the Falk system of cast welding has undoubtedly been a success in the United States; it was employed between 1896 and 1900, but since then the process has been apparently more or less ousted by the electric welding process. One of the drawbacks to the continued commercial success of the cast-welded joint appears to be the size of the equipment required and the fact that it came expensive unless a large number of joints could be poured at one time, which often proved to be inconvenient. The electric conductivity appears to be good, better than

the usual allowance of copper bond. The welding process is quoted as a good example of the determination with which Americans will extend energy, time and money on any new process which they believe can be made a commercial success. The development of the electric welding process is briefly sketched. The thermit system of welding is "a most interesting process and one which would appear to have a great future before it, not only for the welding on street rails. In some of its other applications it is practically without a rival." Several rail joints made by this process are under test on their latest extension on the Drumcondra line and so far appear to have satisfied expectations. The conductivity of a length of rail with the joint appeared as good and in some cases better than a similar length of rail without joint.—Lond. *Elec.*, May 13.

Single-Phase Traction.—A note stating that Dawson, as a witness before the Royal Commission on London Traffic, recently advocated the use of single-phase alternating-current motors for suburban railways, with reference to the motors of Finzi and Lamme and to the great advantage of a 2,000 to 3,000 trolley wire. There will be no longer any necessity for the third rail with its cumbrous and dangerous fittings at ground level, while step-down and step-up transformers with rotary converters will be abandoned. With a single-phase system, the conductor is cheap to install, so that a trial can be made on a selected section of line without great expense and with very little disturbance of general traffic. Since we are not yet within sight of the electric driving of long-distance trains, any system to be adopted must permit of the continuous use of the locomotive on the same lines as the electric trains. Nothing lends itself to this so easily as the trolley wire.—Lond. *Eng'ing*, May 13.

REFERENCES.

High-Speed Railroads.—PETERSON.—The conclusion of his article on railroads running at a speed as high as 200 km. per hour. He discusses the track and rail construction and arrives at a result that the obtainable speed is limited in first line by the degree of exactness to which the rails can be maintained true in position, and only in the second line by the strength of the track construction. He considers the single-rail suspended road as the most suitable one and recommends that further trials should be made.—*Elek. Bahnen*, No. 9, May.

Saint Louis.—An article on some features of the East St. Louis & Suburban Railway, directly opposite St. Louis. One of the two lines leading to Belleville is used almost entirely for hauling coal from the coal mines nearby. The city lines in East St. Louis are operated directly from direct-current generators, but the rest of the system is fed by sub-stations which receive alternating current transmitted at 13,000 volts. The transmission wires are of aluminum.—*St. R'y Jour.*, May 14.

Hanover.—LIEBENBERG.—A fully illustrated description of the new trolley system of Hanover. Accumulator traction was formerly used on this system, but the following disadvantages were found very troublesome: danger due to explosion of gases developed in the accumulators, no reliability of prompt service, the trouble and the expense of the attendance of the batteries. The trolley system has now been introduced and the system is described at great detail.—*Elek. Zeit.*, May 5.

New York Central.—An editorial discussion of the reasons for the use of electric locomotives for through trains on the New York Central Railroad within a zone in which the suburban trains will be operated by electricity. This zone is 34½ miles long on one division and 21 miles on another division. The use of electricity was required by law for only a short section, about 3½ miles in length. The discussion to use electricity for the entire distance is commended.—*St. R'y Jour.*, May 14.

Scarborough.—An illustrated description of the Scarborough electric tramways which use the trolley system. The power plant contains two 300-kw steam turbines.—Lond. *Elec. Times*, May 12.

Train Testing.—ASHE.—A description of the instruments used and the methods followed in making a series of train tests. A number of curves are presented showing speed, voltage, amperes, kilowatts, acceleration and distance.—*St. R'y Jour.*, May 21.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging for Electric Energy.—SCHOENBORN.—An article in which the author says that the theoretically most correct and most fair systems of charging for electrical energy can be introduced into practice only with great simplifications and have remained so imperfect that only very few plants have introduced them. If one abandons the idea of accomplishing what really is impossible, he thinks there are only left two systems which are practical: the double tariff and the tariff based of the hours of consumption. The latter tariff is based on the consideration that a consumer of electric light who uses 600 hours is more favorable than if he uses the light for only 300 hours, since in the former case he will consume some energy during the hours of relatively low load. This tariff, if supplied to lighting only, is, therefore, apt to flatten the peak of the load curve and make it broader. The same system, however, has not the same effect if applied to energy for power purposes. For the use of power the double tariff seems more advantageous. Fig. 2 shows the action of the two

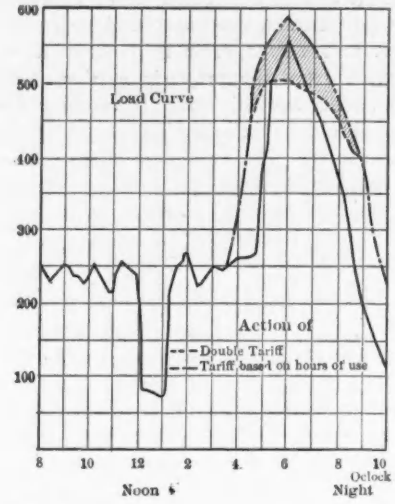


FIG. 2.—CHARGING FOR ENERGY.

systems on the load curve for a lighting system only. If one takes into account the cost of introduction of one of these systems into a plant which has not formerly used it, the general introduction of the tariff based on the hours of use is cheap and the introduction of the double tariff is expensive, because the meters so far used have to be removed and new meters must be installed. A small cost is involved in the introduction of the tariff based on the hours of use for lighting only and of the double tariff for power; in this case the meters for measuring power which are to be replaced by double tariff meters can be installed for new light consumers.—*Elek. Zeit.*, May 12.

REFERENCES.

Switchboard for Tramway Station.—A fully illustrated description of the switchboard for the London County Council tramway power house. It is on the "remote control" system which has been used in several plants in this country and is now being introduced in England.—Lond. *Elec.*, May 13.

Non-Arcing Lightning Arrester.—A description of a lightning arrester in which the discharge is led through a combination of carbon and mica plates having intervening air-gaps, the result being that the static discharge is broken up into infintesimal sparks and conducted to the ground.—*St. R'y Jour.*, May 14.

ELECTRO-PHYSICS AND MAGNETISM.

Structure of Atom.—NAGAOKA.—A mathematical paper on the "kinetics of a system of particles illustrating the line and the band spectrum and the phenomena of radioactivity." His model consists of a large number of particles of equal mass arranged in a circle at equal angular intervals and repelling each other with forces inversely proportional to the square of distance; at the center of the circle a particle of large mass is placed attracting the other particles according to the same law of force. If these repelling particles revolving with nearly the same velocity about the attracting center, the system will generally remain stable, for small disturbances, providing the attracting forces be sufficiently great. The system differs from the Saturian system, considered by Maxwell, in having repelling particles instead of attracting satellites. The model is approximately realized if these satellites are replaced by negative electrons, and the attracted center by a positively charged particle (this model differs from that recently described by J. J. Thomson, in so far

as Thomson's uniformly electrified sphere is replaced by a positively charged particle in the center). This model is applied to a mathematical investigation of the line and bond spectrum and the author thinks that various other problems will possibly be capable of being attacked on the same hypothesis, such as chemical affinity and valency, electrolysis and other subjects connected with atoms and molecules. —*Phil. Mag.*, May.

Thomson Effect in Alloys of Bismuth and Tin.—LAWS.—An account of experiments which show a striking effect of the addition of a very small amount of tin to bismuth, the Thomson effect in the alloy containing 1 per cent. tin being more than twelve times as much as in pure bismuth. With the addition of more tin the value of the Thomson effect continues to increase until the alloy contains about 3 per cent. of tin when the effect is about fifteen times as much as for bismuth. When the percentage of tin is increased beyond this amount, the value of the specific heat of electricity begins to decrease and this diminution goes as the amount of tin becomes greater, until finally the Thomson effect in the case of pure tin has fallen to a value which is only about 1/300 part of that which holds in the case of bismuth.—*Phil. Mag.*, May.

Resistivity of Mercury.—GUILLAME.—A note referring to the elaborate tests of Smith on the variation of the resistivity, R, of mercury with temperature, t. Smith gives the following equation:

$$Rt = R_0 (1 + 0.00088036\ t + 0.0000010309\ t^2).$$

The author formerly found the following equation to hold true:

$$Rt = R_0 (1 + 0.00088090\ t + 0.0000009986\ t^2).$$

Both formulas are nearly the same, but the author thinks that his own formula is a little more exact.—*L'Ind. Elec.*, May 10.

REFERENCES.

Influence of Radium on the Electric Spark.—A note on experiments of Stefanini and Magri, who found that for discharges between two spheres, or between a positively charged point or sphere and a negative disc, the discharge is facilitated by radium for short sparking distances and impeded for longer ones. If the disc is positive and the sphere or point negative, the discharge is impeded at small sparking distances within a limited interval; in general the effect is nil. For certain sparking distances between a sphere and disc it is possible for radium to impede or facilitate discharge according to which electrode is positive.—Lond. *Elec.*, May 6.

Power Factor.—An illustrated didactic article treating of combined capacity and inductance and power factor.—*Am. Elec.*, May.

ELECTRO-CHEMISTRY AND BATTERIES.

Osmotic Pressure.—SEBOR.—An account of an investigation of the speed of diffusion of water through a semi-permeable diaphragm. The speed of diffusion is approximately directly proportional to the osmotic pressure of the dissolved substance. It seems possible to determine from the speed of diffusion the osmotic pressure and the molecular weight of the dissolved substance.—*Zeit. f. Elektrochemie*, May 13.

REFERENCES.

Electrolysis of Sulphites.—FRIESSNER.—An extended investigation of the electrolysis of sulphites. If neutral or alkaline sulphite of sodium or potassium is electrolyzed, the anodic reaction is the oxidation of the sulphite to sulphate and under certain conditions dithionate may be formed. The latter formation may be compared with persulphate and percarbonate formation. The conditions under which it takes place are investigated in detail.—*Zeit. f. Elektrochemie*, April 22.

Electrochemistry.—IZART.—A concise review of the present condition of the various electrochemical industries in the world.—*L'Ind. Elec.*, May 10.

Concentration of Hydrogen Ions.—SALM.—A paper on the possibility of determining the concentration of the hydrogen ions in a solution with the aid of indicators.—*Zeit. f. Elektrochemie*, May 13.

UNITS, MEASUREMENTS AND INSTRUMENTS.

System of Units.—EVERETT.—A communication on the completion of the practical system of units, with reference to recent suggestions of Robertson. The proposed changes involve the selection of units of mass, length, time and magnetic permeability that will give the ohm, volt, etc., without the introduction of arbitrary multipliers. This is accomplished by using the kilogram and meter as fundamental units and employing a unit of permeability 10^7 times the permeability of vacuum, and the permeability of vacuum equal to 10^{-7}. Secondly, it is suggested to so alter the units of permeability and permittivity as to make Heaviside's "rational" formulas applicable. The permittivity of vacuum then becomes $\frac{1}{36\pi} 10^{-9}$ and the permeability of vacuum $\frac{1}{4\pi} 10^{-7}$. When the rational values of permitivity and permeability are employed in conjunction with the kilogram, meter and second, the capacity of a condenser is area divided by thickness multiplied by permitivity; and the induction within a long helix carrying a current is ampere-turns per unit length multiplied by permeability. When the units used as fundamental are coulomb, meter, kilogram, second, there are fractional exponents in the dimensions of the electrical and magnetic units, and he inclines to the adoption of the coulomb rather than the ohm, because a specified number of grams of silver is a more matter-of-fact thing than a resistance. Moreover, it does not vary with temperature as a materialized resistance does. For kilogram he suggests the name kilog and for meter the abbreviation met.—Lond. *Elec.*, May 13.

Measuring the Phase Difference of Three-Phase Generators.—BAUCH.—In generator tests it is important to determine exactly the phase difference between the current and voltage. For this purpose the watts are measured with the wattmeter and voltage and current with a voltmeter and ammeter, respectively. This measurement may involve a considerable error, especially if the generator is star-connected, for the reason that the star voltage may have a wave form considerably different from the tension between the terminals. This is possible because the former may contain harmonics of the third order, which need not occur in the tension between the terminals. The author investigates mathematically how far it is possible with the usual methods of measuring to determine correctly the watts and the phase difference. Several connections are discussed for measuring the phase difference for different conditions of wave form and load. The author shows that there exists no means for measuring accuracy the wattless component of the current for inductive load by means of only one watt, current and voltage measurement.—*Zeit. f. Elek. u. Masch.* (Potsdam), April 16.

Utilizing Old Day Batteries.—HANCHETT.—A short article giving a few uses to which old dry batteries may be put in testing. The common expedient to obtain low voltage when only a high-voltage circuit is available, is to connect the circuit to be supplied in multiple with a suitable resistance which is connected in series with the line. This resistance is not always easy to obtain, and aside from being inconvenient, is a source of heat and requires more current from the line than is used in the derived circuit. A very convenient means of eliminating this difficulty is to use a sufficient number of dry battery cells in place of the resistance, selecting such a number as will give an open-circuit voltage equal to the desired voltage at the work circuit. If the apparatus is so arranged there will be practically no current flowing through the dry cells when the work circuit is closed, so that the dry cells will not be a source of heat or trouble and also have the advantage of being very compact and a convenient substitute for the resistance and one easy to secure. In the case of a three-wire system, where the neutral is grounded, a bell circuit might be supplied in shunt to a set of dry cells connected in series with a lamp circuit which was continuously alive and on the side next to the neutral wire. If the current in this lamp circuit is kept down to a reasonable amount, it is probable that very little trouble will be experienced in the battery in a number of years. The greatest value of the battery "resistance" is its convenience as a laboratory expedient. —*Am. Elec.*, May.

REFERENCES.

Alternating-Current Integrating Wattmeter.—An illustrated description of the Brush-Gutmann integrating wattmeter for alternating currents. It is of the induction motor type. The readings which are direct in watt-hours are stated to be true within 2 per cent. from the starting load to 50 per cent. overload for meters up to 50 amp. and in larger sizes within 3 per cent. from starting to 25 per cent. overload. Temperature changes are said to have no effect from 40 to 120° F. The construction of the meter is described. —Lond. *Elec.*, May 6.

Reichsanstalt.—An abstract of a long official report of the work of the German Reichsanstalt from the beginning of 1900 to the end of 1903. Since the account is very concise, it cannot well be abstracted.—*Elek. Zeit.*, May 12.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Four-Party Selective Ringing System.—O'BRIEN.—An illustrated description of the Leich system. Two instruments are connected to each side of the line and at the central office two generators are provided which furnish current at different frequencies. There are two types of instrument used with the system, the difference between them being entirely in the arrangement of the ringing circuit. Each type of instrument is equipped with a 1,000-ohm ringer, a retardation coil and a condenser. The circuit arrangement of this apparatus, however, differs materially in the two cases. In operating one of the two different sources of ringing current at the central office furnishes 60-cycle current and the other furnishes 20-cycle current. The division of the instruments into two types is due to the fact that one is designed to respond to a ringing current of low frequency while the other is intended for a high-frequency current. In the former instrument a two-microfarad condenser and a 2,000-ohm retardation coil are connected in series with a 1,000-ohm ringer, the free terminal of which is grounded. With this arrangement, the impedance of the ringing circuit for the low-frequency instrument will increase directly as the frequency of the ringing current increases, so that a point may be reached where the frequency of the ringing current has become so high and the impedance of the circuit so great that sufficient current cannot pass through the ringer to actuate it. With the high-frequency instrument, the arrangement of the ringing circuit consists in connecting a 0.3-microfarad condenser in series with a 1,000-ohm ringer, the free terminal of which is grounded, and bridging the ringer with a 1,000-ohm retardation coil. The action of a condenser in an alternating-current circuit is directly opposite to that of a retardation coil. The impedance offered to the flow of the alternating current by a condenser varies inversely with the frequency of the current, so that with the high-frequency instrument the impedance offered to a 60-cycle current is considerably less than that offered to the 20-cycle current. The particular impedance coil used with this system is designed so that its impedance may be varied to suit unusual line or switchboard conditions. For this purpose the core of the coil is made up of a number of E-shaped annealed iron punchings which can be readily inserted or withdrawn so as to adjust the impedance of the coil. Instruments equipped with this type of selective apparatus have been successfully operated over lines up to ten miles in length, without any adjustment whatever.—*Am. Elec.*, May.

Train Dispatching.—A description is given of the telephone dispatching system used by the Rochester & Eastern Rapid Railway Company. The dispatching line consists of a pair of copper wires carried on porcelain insulators on brackets below the high and low-tension feed wires. At switches and other convenient points jack boxes are fastened to the poles and connected by water-proof wires to the telephone line. Where connection is desired in emergencies and no pole box is near, a connecting hook pole is used, the bottom of which contains a socket into which the telephone plug can be inserted. —*St. R'y Jour.*, May 21.

Independent Telephone Development in the Northeast.—An illustrated description of the automatic telephone exchange of the Northeastern Telephone Company at Portland, Me. The underground system and aerial lines are sufficient to accommodate 5,000 subscribers on outside construction, and the ultimate exchange capacity will be for 10,000 subscribers; 2,500 automatic switches are already installed in the exchange and the full capacity limit for the switches already installed is expected to be reached during the year. The company has now 250 miles of rural pole line construction with about 175 miles of trunk line connecting between 60 and 70 towns, villages and cities in northeastern Maine, with 12 exchanges and 75 to 80 pay stations outside of Portland. It connects with several rural and farmer lines covering territory adjacent to the company's main lines. It is also under its licensee company's management, the Lewiston-Auburn Telephone Company, preparing to build an exchange for those two cities connecting by trunk line with the company's main exchange in Portland, 35 miles away.—*Am. Elec.*, May.

REFERENCE.

Wireless Telegraph Transmitter.—MENDELSTAM.—A mathematical article giving the fundamental equations of the theory of the Braun transmitter, that is the theory of two coupled electric systems.—*Phys. Zeit.*, May 1.

New Books.

RUBBER, GUTTA-PERCHA AND BALATA. By Franz Clouth. New York: D. Van Nostrand Co. 242 pages, illustrated. Price, $5.

This is an English version of the original German treatise, known for many years past to students of the subject treated. Good judgment has been shown in making the translation and in adding a quantity of new material. In each instance of the three substances the author deals with its history, habitat, properties, methods of handling in refinement, and commercial uses of the manufactured product. Unfortunately, there is no index, but the chapter contents give a summary of topics. We can heartily commend this work to all our readers—and they are not a few—specially interested in the important problems of electrical insulation.

ANWENDUNG UND ZUKNFT DER KONDENSATOREN IN DER WECHSELSTROMTECHNIK. By W. Von Bisicz. Berlin: Julius Springer. 88 pages, 26 illustrations. Price, 3 marks.

This is a compendium of quantitative information concerning condensers in alternating-current distribution circuits. The applications of condensers in telegraphy and telephony are not considered. The leading formulæ controlling condenser currents and pressures are clearly given and the bibliographical references are very numerous. In fact, the main value of the book lies in the copiousness of its references.

The book is divided into seven chapters. The first is introductory. The second and third deal with condensers in series and in parallel respectively. The fourth and fifth deal with particular arrangements of condensers. The sixth and seventh relate to practical considerations concerning the use of condensers.

It is shown, among other things, that the cost of a condenser varies directly as the capacity and as nearly the square of the impressed voltage. That is to say, the cost varies approximately as the energy storage capacity. The book is useful as a reference index for electrical engeineering students interested in condensers.

CYANID PROZESSE. Zur Goldgewinnung. By Manuel von Uslar and Dr. Georg Erlwein. Halle: Wilhelm Knapp. 100 pages, 32 illustrations. Price, 4 marks.

This is the seventh volume of the well-known German serial of monographs on applied chemistry. It gives a review of the cyanide processes for gold production and deals both with zinc precipitation and with electrolytic precipitation. The first chapter gives a description of the McArthur-Forrest and the Siemens & Halske processes. The second chapter contains examples from practice with cost sheets. In the third chapter the author discusses the chemical reactions during solution and during precipitation and in the fourth chapter he gives a review of the various modifications of the original McArthur-Forrest and Siemens & Halske processes, which have either been proposed or introduced into practice.

The compilation is well done and the statements and descriptions are concise and clear. The various processes which have been proposed are critically discussed, and the book appears to give complete information on the cyanide process up to about 1900 or 1901. In a later edition the more recent developments—and especially the interesting combination of electrolytic with zinc precipitation, due to Charles Butters—should be considered.

AMERICAN METER PRACTICE. By Lyman C. Reed. New York: McGraw Publishing Company. 196 pages, 78 illustrations. Price, $2.

Since substantially all electrical energy sold is measured by some form of meter, the subject of metering is one of much importance. Its literature, however, is surprisingly meagre, Mr Reed's book being almost the first on the subject. Great literary merit would perhaps be too much to expect in an extremely practical treatise by a busy "meterman" such as the author. A prominent editor, being asked whence came his remarkable facility of expression, replied "that is not as easy as it looks: I rewrite everything four times." The first chapter of "American Meter Practice" did not, apparently,

receive sufficient revision, for some errors contained are evidently due to carelessness rather than to unfamiliarity with the subject. The intended meaning will, however, be obvious to the central station "meterman," for whose instruction the book seems to be especially written.

The chapter on meter selection is very satisfactory and that on torque and friction is especially so, due, perhaps, to its having benefited from the revision and criticism incident to previous publication in the technical press. The passing of the chemical meter is appropriately noted, and its successor, the "motormeter," in its various makes, is discussed at some length, but not exhaustively. Chapter XII on records and testing is perhaps more indicative of individual than general practice. With the avowed purpose of enabling the non-technical consumer of electric energy not only to read his meter but roughly to check its accuracy, full directions are given for so doing. On page 169 it is stated that the average meter underregistration causes a 15 per cent. loss of revenue to the supply company. This figure is, however, wide of the mark in the case of cities where the more modern bearings, friction compensating appliances, testing methods, etc., are employed. Differential rating is interestingly discussed, and the book closes with an excellent chapter on photometry, which is evidently "thrown in for good measure," as it is not covered by the title of the book. Persons engaged in the electric light and power industry will find the book as a whole especially valuable.

BOOKS RECEIVED.

THE THEORY OF THE LEAD ACCUMULATOR. By Dr. Friedrich Dolezalek. Translated from the German by Dr. Carl L. von Ende. New York: John Wiley & Sons. 241 pages, 30 illustrations. Price, $2.50.

N. E. L. A. International Congress Delegates.

Three papers will be presented at the International Electrical Congress at St. Louis on behalf of the National Electric Light Association, as follows: "American Practice in High-Tension Line Construction and Operation," by Dr. F. A. C. Perrine, Pittsfield, Mass. "American Meter Practice," by G. Ross Green, Philadelphia, Pa. "The Protection and Control of Large High-Tension Distribution Systems," by George N. Eastman, Chicago.

New York Central Electric Locomotives.

In our issue of May 21 we presented a review of the reasons that may be taken as those which have influenced the New York Central & Hudson River Railroad Company in adopting electric traction for a 40-mile zone around Manhattan Island. We are now glad to be able to present some details as to the type of locomotive to be adopted, and to illustrate these new machines. As we have already said, no more important departure in years has been taken than that to which is due the creation of such remarkable locomotives, the finest exemplification of the electric traction art to-day.

The new electric locomotives which are being built for the New York Central & Hudson River Railroad Company at Schenectady, by the General Electric Company and the American Locomotive Company, differ radically in their electrical features from any electric locomotive hitherto constructed. The motors are bipolar gearless, the magnetic circuit, the field windings and the motor poles being integral with the locomotive frame and spring supported. The pole faces, which are laminated, are vertically tangential to the armature, thus providing for vertical movement of the locomotive frame with attached poles without affecting the armature air-gap. The armature is assembled on a quill which is pressed solidly on the axle. The dual weight of the assembled rotating part, including the armature, axle and wheels, is less than on many steam locomotives, and there being no uncompensated reciprocating parts there is a perfect rotative balance.

This design was submitted in accordance with specifications prepared by the Electric Traction Commission appointed by the railroad company, the members of which are Messrs. William J. Wilgus, fifth vice-president New York Central & Hudson River Railroad; John F. Deems, general superintendent of motive power of the railroad company; Bion J. Arnold, Frank J. Sprague and George Gibbs. The secretary to this commission is Mr. Edwin B. Katte, electrical engineer of the railroad company. This commission, after careful deliberation, had prescribed the conditions which must be fulfilled by electric locomotives taking the place of steam locomotives as far as Croton on the Hudson River line and as far as North White Plains on the Harlem Division, a distance of 34 miles and 24 miles respectively.

These conditions were, briefly, that the successful bidder should furnish an electric locomotive capable of making two regular successive trips of one hour each between Grand Central Station and Croton with a total train weight of 550 tons, a single stop in each direction, and a lay-over not to exceed twenty minutes. In addition to this it was provided that a similar schedule should be maintained with somewhat lighter trains making more frequent stops. Finally, it was provided that with a total train weight of 435 tons, the electric locomotive should be able to run from Grand Central Station to Croton without stop in forty-four minutes, and, with one hour lay-over, be able to keep up this service continuously. This last schedule is the equivalent of the present timing of the Empire State Express, though the latter has a somewhat lighter train.

Specifications embodying these conditions were prepared by the commission and sent to all the principal electrical manufacturing companies both here and abroad. It will be observed that no restriction was placed on bidders as to whether direct or alternating current was to be used. The successful bidders were the General Electric Company in conjunction with the American Locomotive Company. The choice of a direct-current type of locomotive was dictated largely by its known reliability of service, owing to the amount of experience which had been accumulated with the direct-current motor.

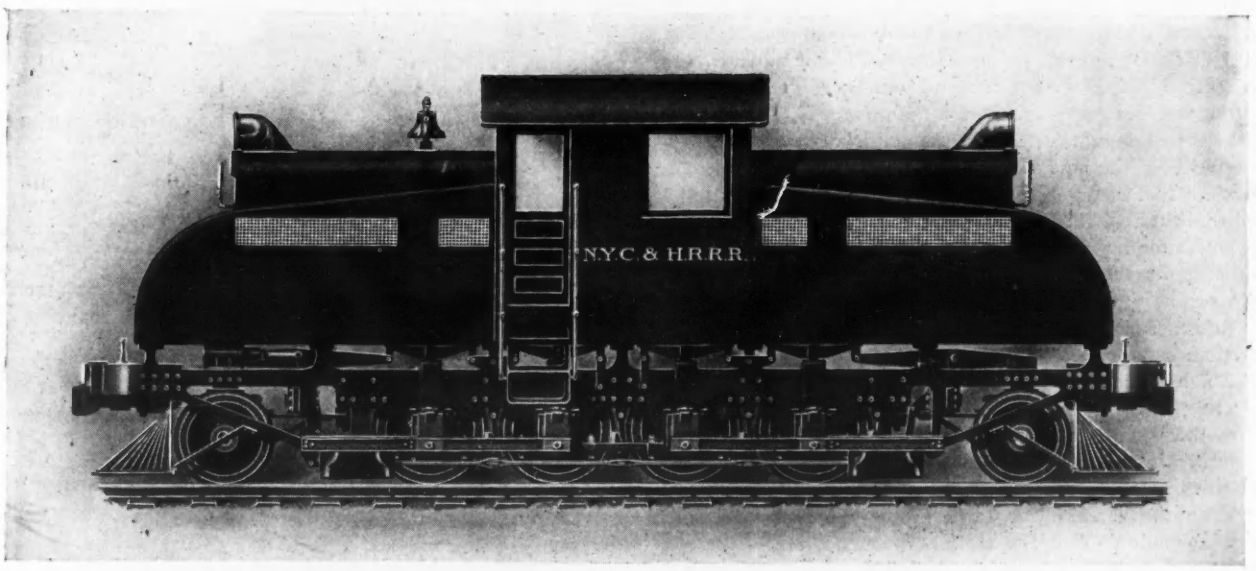


FIG. 1.—ELECTRIC LOCOMOTIVE FOR NEW YORK CENTRAL RAILROAD.

The new electric locomotive will be 37 ft. in length over all. The

wheel base will consist of four pairs of motor wheels and two pairs of pony truck wheels, the length of the total wheel base being 27 ft., and of the rigid wheel base consisting of the four pairs of motor wheels 13 ft. The diameter of the driving wheels will be 44 in. and of the truck wheels 36 in. The driving axles will be 8½ in. in diameter. It will be what is known as a double-ender and will weigh approximately 190,000 pounds.

The frame is of cast steel, the side and end frames being bolted together at machined surfaces and stiffened by cast-steel cross transoms. The journal boxes and axles are designed to permit sufficient lateral play to enable the locomotive to pass easily around curves of 230 ft. radius.

The superstructure of the locomotive is to be of steeple form so designed as to offer the least practicable wind resistance consistent with the adequate housing of the apparatus and its convenient operation. The cab is designed so as to afford a clear view of the track. The whole of the superstructure is to be of sheet steel with angle iron framing, and the doors and windows of the cab are to be fireproof.

The driving power of the locomotive is furnished by four 600-volt, direct-current, gearless motors, each of 550 hp. This will make the normal rating of the locomotive 2,200 hp with a maximum rating of about 2,800 hp, or about 50 per cent. greater than that of the largest steam passenger locomotives now in service. The armatures are mounted directly on the axles and will be centered between the

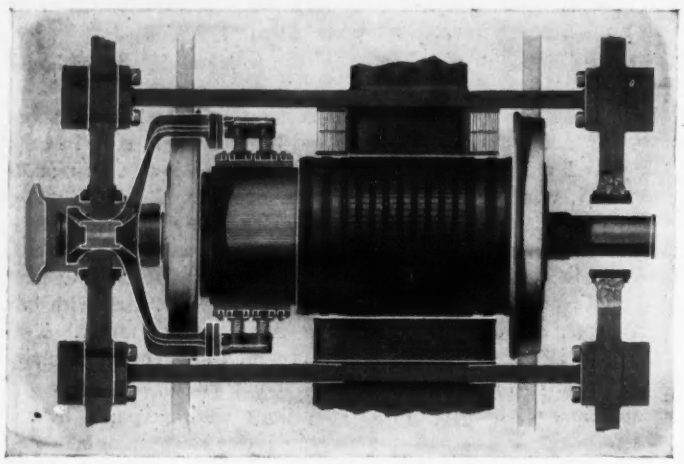


FIG. 2.—MOTOR FOR NEW YORK CENTRAL LOCOMOTIVE.

poles by the journal boxes, sliding within finished ways in the side frames. The armature core is of the iron-clad type, the laminations being assembled on a quill which will be pressed on the axle. The winding will be of the series drum-barrel type. The conductors are designed so as to avoid eddy currents and will be soldered directly into the commutator segments.

The commutators are supported on the quill. The commutator segments are made of the best hard-drawn copper and will have the ears integral with themselves. The brush holders are of cast bronze and mounted on insulated supports attached to the spring saddle over the journal, maintaining a fixed position of the brush holder in relation to the commutator.

Unlike the ordinary four-pole motor where the magnetic circuit is made through a separate box casting, the magnetic circuits in this type of electric locomotive are completed through the side and end frames. The pole pieces are cast in the end frames and there are also double-pole pieces between the armatures carried by bars which act as part of the magnetic circuit. The pole pieces are shaped so that the armature is free to move between them with ample clearance on the sides. As the poles move up and down with the riding of the frame on the springs, they will always clear the armature and provision is made so that the armature will not strike the pole pieces even if the springs are broken. The field coils will be wound on metal spools bolted to the pole pieces and will consist of flat copper ribbon.

The Sprague-General Electric multiple-unit control is to be used on this type of electric locomotive. There are two master controllers in the cab so placed that the operating engineer looking ahead will always have one of these under his hand. The control system permits two or three locomotives to be coupled together in any order in which they happen to come and to be operated as one unit by the engineer in the leading cab.

The control system is also semi-automatic in its action, as it provides check on the rate of acceleration of the train, which the engineer cannot exceed, while he may accelerate at any slower rate if he so desires. Should two locomotives break apart, the control current will be automatically and instantly cut off from the second locomotive without affecting the ability of the engineer in charge to control the front locomotive under his charge. The control system is designed for a minimum of 300 volts and a maximum of 750 volts.

The weight which rests upon each of the driving wheels of the electric locomotive will be about 17,000 pounds, proper distribution and division of the weight among axles being accomplished by swinging the main frames from a system of elliptical springs and equalizing levers of forged steel, the whole being so arranged as to cross equalize the lead and furnish three points of support. The locomotive is provided with all the usual accessories of a steam locomotive, including an electric air compressor to furnish air for the brakes, it will have whistles, a bell and an electro-pneumatic sanding device and electric headlights at each end. The interior of the cab will also be heated by electric coils.

In actual performance this locomotive is expected to give better results than any engine hitherto placed upon rails. With a light train the locomotive is expected to give speeds up to 75 miles an hour, and with heavier trains similar speeds can be attained by coupling two locomotives together and working them as a single unit. Its tractive force will be greater than that of any passenger locomotive now in existence, and it is believed that in the simplicity and accessibility of its parts and in the provision made in its design to insure continuous operation with the minimum chances of failure, that it marks an entirely new and successful type of electric locomotive.

A New Slip Meter.

BY FRANZ WELZ.

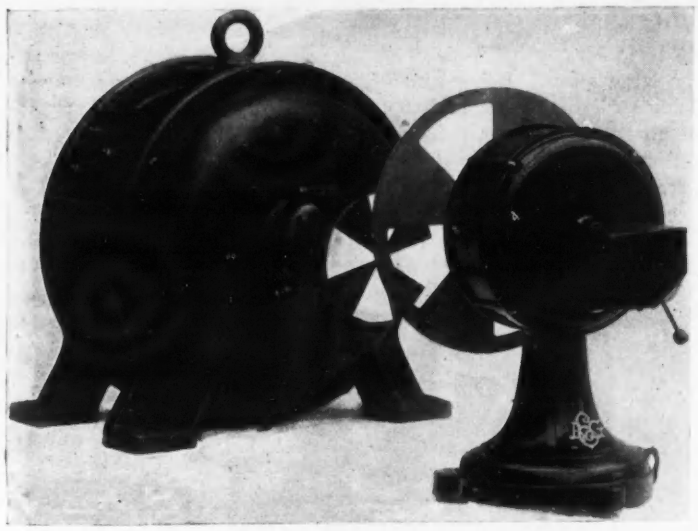
At a recent meeting of the German Institute of Electrical Engineers, Mr. G. Benischke, chief electrician of the Allgemeine Elektrizitäts-Gesellschaft, gave a description of his new apparatus for measuring the slip of induction motors. This effect is determined by the formula, $s = \frac{u_1 - u_2}{u_1}$, where u_1 is the number of revolutions of the rotating field and u_2 the number of revolutions of the rotor. As the difference between these two values is generally very small, the correct determination of the slip is quite difficult, and small errors in taking the above-mentioned values affect the result very largely. Mr. Benischke had, therefore, indicated a method which allows a direct reading of the difference, $u_1 - u_2$, in making use of the so-called stroboscopic effect well known in physics.

According to this method, the shaft of the rotor is provided with a disc which is divided in several black and white segments. This disc is lighted by an arc lamp, which is fed through the same distribution system as the induction motor. The number of passages of these segments before a fixed point in a certain time allows the determination of the difference $u_1 - u_2$. But in addition it is still necessary to know the number of cycles of the current, or the number of revolutions of the generator. In many cases it is not advisable to use an arc lamp on the circuit, as it results in an unequal distribution of current in the three phases on account of its high amperages. In using an incandescent lamp, this stroboscopic effect is only visible in a darkened room.

From this method Mr. Benischke has developed a very simple apparatus which permits the determination of the slip in a convenient and absolutely accurate manner. No light source is necessary, nor is a record of the time to be made; neither does it require a special instrument for determining the number of revolutions. The apparatus (see illustration) consists of a small three-phase synchronous motor, which is self-starting and reaches synchronism very quickly. A disc, from which a number of segments is cut out, is attached at one end of the shaft and on the other end there is a counter, driven by rack and pinion, which can be thrown in and out by a little lever. A stroboscopic disc is attached by means of wax to the shaft of the induction motor to be tested. This disc consists of black and white segments of the same number as on the disc on the synchronous motor. The latter motor is put at a certain distance from the in-

duction motor, and if both are running and the observer looks through the disc of the synchronous motor upon the other disc, the segments seem to rotate. The number of passages before a fixed point can be counted very easily, and this gives the difference $u_1 - u_2$; the number of revolutions of the rotating field, u_1, is given simultaneously by the counter. The value of the formula above given is not dependent on the time, and it is, therefore, of no importance for which period of time the values $u_1 - u_2$ and u_1 are taken; the only condition is that only values taken at the same time are to be compared. It is, therefore, not necessary, as in the case of the method of illuminating the disc or with other methods of counting the pulsations of current in the rotor, to record simultaneously the time, all that is necessary being to count the numbers of passages of the segments and read from the counter of the synchronous motor the number of revolutions during that time. The quotient of the first value by the latter gives the slip of the motor.

The simplest arrangement is that in which the disc of the synchronous motor and that of the induction motor have the same number of segments, and it is best to use for this number the number of poles of the induction motor to be tested. In order to get actually



SLIP METER.

the difference $u_1 - u_2$, it is necessary to divide the observed number of passages of the segments by the number of the segments on the disc of the induction motor. If the slip is very large, the segments turn too quickly to make it possible to count the number conveniently. In this case it is best to employ a disc with only one segment; the observed number of passages is then equal to the number of "slipped" revolutions. This involves another advantage compared with the method of counting the number of pulsations of current in the rotor. These pulsations follow each other so quickly in the case of a large slip (commencing at about 0.06) that they cannot be counted with any accuracy; with this new apparatus the number of slipped revolutions can be counted directly by employing discs with only one segment. In order to obtain good results it is necessary to place the synchronous motor at a greater distance from the induction motor than is shown in the illustration, as the stroboscopic effect is better visible in proportion as the distance increases.

Long Scale Portable Instruments.

Electrical engineers who employ the portable standard instruments in general use for the making of exact measurements of electrical quantities or in the conduct of tests, know how difficult it is to take accurate observations in those portions of the scale where the divisions are narrow, and the consequent uncertainty regarding results and difficulty in checking up a series of measurements taken with different instruments. The fact that only a portion of the scale is accurately legible and that it is not always possible to have at hand instruments of the proper range to cover all capacities properly, make it at times impossible to avoid the use of comparatively illegible divisions, and as a result the curve sheets of tests and tables of measurements show irregularities which rob the work of all value.

To obviate such troubles and the other embarrassments resulting from the use of imperfect standards, the Department of Standards of the Westinghouse Electric & Manufacturing Company has designed the portable instruments illustrated herewith. The assortment comprises voltmeters, ammeters and single-phase and polyphase wattmeters. Their principal characteristics are convenience in use, permanence of calibration, accuracy and mechanical excellence.

As shown by the illustration, the voltmeter is zero-reading, this form having been found most suitable for measurements for which

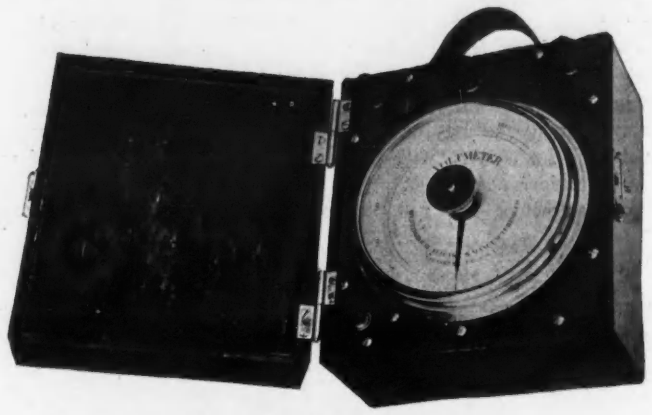


FIG. 1.—PORTABLE VOLTMETER.

a voltmeter is used. In this form the readings are determined by the deflection of the milled head required to bring the index pointer to zero. Each instrument is made in two capacities, which in connection with the very long, open scale enables the readings to be

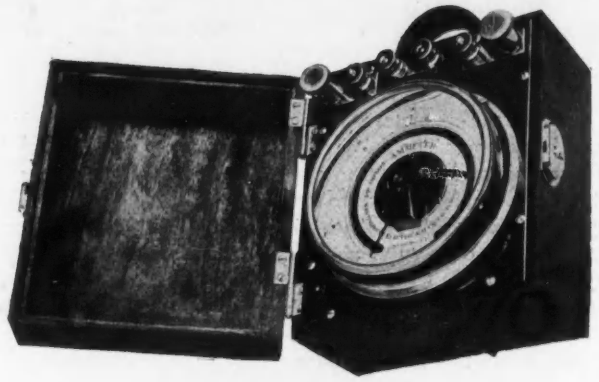


FIG. 2.—PORTABLE AMMETER.

taken over a wide range of voltage with great accuracy. It is a static and, therefore, unaffected by external fields, and may be used on either alternating or direct currents without a change in calibra-

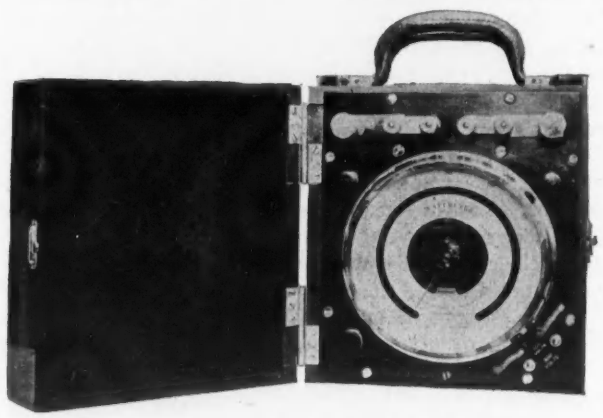


FIG. 3.—SINGLE-PHASE PORTABLE WATTMETER.

tion and without requiring "reverse" readings to be taken on the latter. It is regularly made in capacities up to 600 volts, but may be furnished for any higher range desired by the use of a multiplier. The action is entirely dead-beat.

The ammeter is similar in external appearance to the voltmeter, with the exception of the terminals, which are designed for the use of heavier connecting wires, and the absence of the knurled head with its indicating pointer, this instrument reading direct. It is furnished with coils wound in two sections, which, by means of small connectors on the top, may be connected in series or in parallel, thus

greatly increasing the range of the instruments. The scale is very long and open, being similar to the voltmeter in this respect.

This instrument can be used on alternating currents only, but it is accurate over a very long range of frequencies and may be used on circuits varying from 3,000 to 8,000 alternations without appreciable error. It is also unaffected by changes of wave form on the circuit. The moving element is extremely light and being dead-beat will accurately follow any variation of current.

In the wattmeters the scheme of subdividing the coils as adopted for the ammeters is carried out for both the series and potential windings, thus giving in one instrument four ranges in capacity. In addition to this, as the scales are uniformly spaced from zero to maximum, readings may be taken at any point with equal accuracy, so that one instrument will give a range several times that of any other heretofore obtainable.

The wattmeters are suitable for use with alternating currents

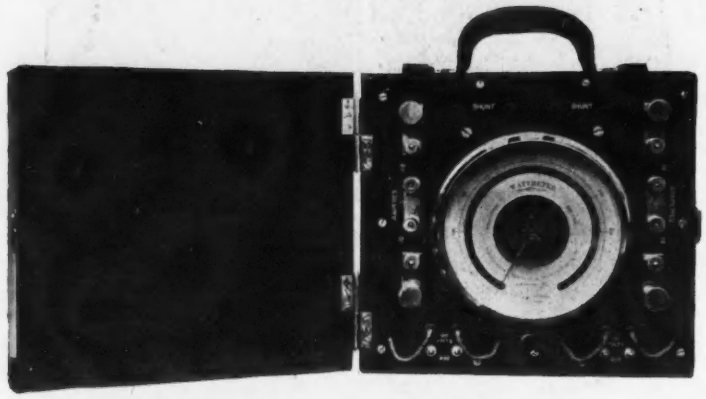


FIG. 4.—POLYPHASE PORTABLE WATTMETER.

only, but like the ammeters, they may be used over a considerable range of frequency. The polyphase instrument consists of two single-phase mechanisms connected to one shaft, and indicating on a single dial the sum of the forces of the two mechanisms. It may be used for either two-phase or three-phase circuits and will indicate correctly the total energy of a polyphase circuit irrespective of power factor or any unbalancing of the different phases. As they are not affected by external fields or proximity to large masses of iron they afford a very convenient medium for making tests of polyphase motors or other devices of this nature under actual service conditions.

Some "Sarco" Specialties.

There is a tendency in this age of great and large achievement to ignore the smaller things, and yet it is the little inventions which often contribute more to the comfort of the human race and in the greater number of instances make it possible for the artisan and mechanic to do his work better. In the field of electrical apparatus these things have been peculiarly noticeable, the inventions which are handled every day by thousands receiving but small attention. It is along the lines of improving the electrical apparatus of every day use, especially that devoted to electric lighting, that the Sarco Company, of 906 Sixth Avenue, New York, has devoted its attention. All of its specialties have distinctly novel features, and include the "Noscru" bell push button, the parabolic aluminum reflector and the "Sarco" outlet boxes. Coupled with these are novelties in the nature of "Key-arm" switches. The "Sarco" two-light aluminum reflector is also of particular interest to those using incandescent lamps and wishing an increased light in two directions.

As a practical novelty the "Noscru" midget bell push button overcomes a difficulty with which those putting in electric bells have been confronted. As its name may be considered to imply, the wires are connected without screws. The face of the button has an appearance similar to those now on the market, being manufactured in the same size with celluloid and pearl centers; but the bottom of the button is one solid piece of hard rubber, two holes running horizontally through the rubber. The button is connected by simply threading two circuit wires through these horizontal holes and bending over the extended ends flat against the piece at the bottom, there being a projecting ridge of rubber to separate the wires. The method of contact is by a yielding plunger that makes direct scraping contact on the circuit wires themselves. These buttons can be connected in ten seconds, and they are readily taken apart for engraving and stamping, by unbending the two pins that are bent over on the bottom of the button. Dampness cannot affect the "Noscru" push button, since the contacts are enclosed entirely in rubber. It is made in various sizes, the smallest called the "Pee Wee" fitting a ⅜-in. hole, and having the advantage of being screwless, is perhaps the only solution to the practical working of a button of this size. Since these buttons, as well as key-arm switches, which are somewhat of the same type, all make direct contact on the wires, they cannot short-circuit or ground.

The "Sarco" parabolic aluminum reflectors can be applied to a lamp without regard to socket receptacle or "Fielding" receptacle, the lamp fitting perfectly into either. This enables a window or frame to be wired with regular fielding receptacles, and by having the "Sarco" reflector applied direct to the lamp, an even better reflecting power is acquired than by using an expensive mirror trough reflector. By its peculiar shell shape it gains at once in power of reflection. The deep-cone type of reflector brings the polished surface of the aluminum so close to the lamp that it is claimed an actual test with an 8-cp lamp will show as much light as an ordinary 16-cp lamp without the reflector. Like the "Noscru" button, simplicity is the keynote of this reflector's construction and it can be applied without shade holder wherever desired, as in factory lighting, show rooms and for large space. Being also of aluminum it has the advantage of being so light in weight that it adapts itself readily to the purposes of almost any kind of a desk lamp or portable. The finish of the reflectors is solid smooth green enamel, resembling in position a green sea shell. The styles manufactured give either a direct reflection or a wide diffusion of illumination, as desired.

The "Sarco" two-light reflector gives another effect in lighting. By applying it to an 8-cp incandescent lamp it is claimed the value of the light is twice multiplied. As the reflector is held part way down the lamp it gives a reflecting power to the light from the lamp and yet at the same time permits the lamp to light the space

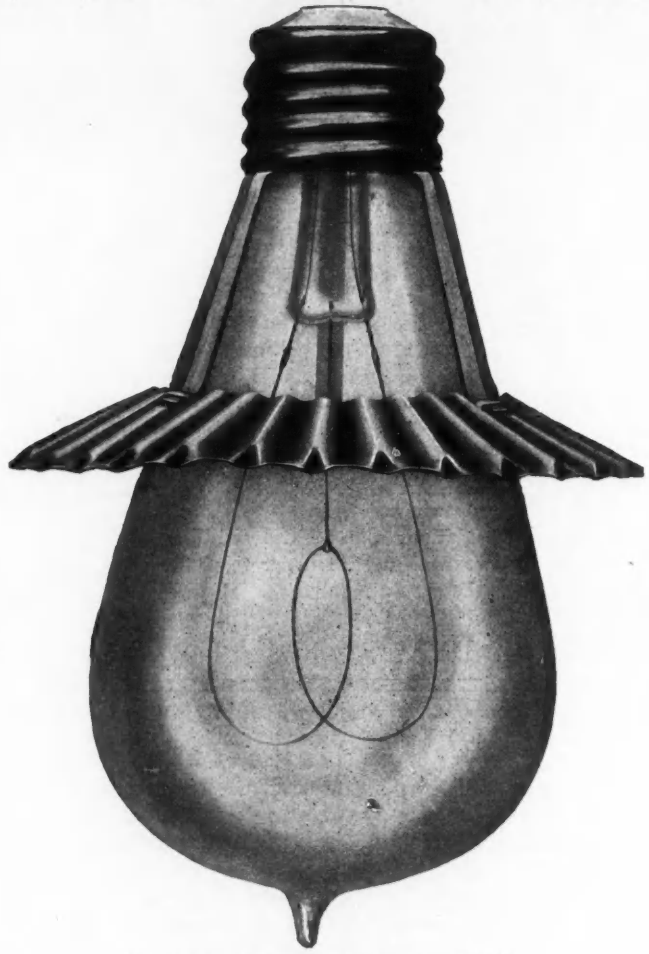


FIG. 1.—2-LIGHT ALUMINUM REFLECTOR.

around it. It is so fixed upon the lamp that it does not in any way interfere with the radiation of the light from all sides of the filament. The two-light reflector is also of polished aluminum and because of its novel construction can be placed inside the ordinary glass shade, thereby increasing the light of the lamp without casting a shadow.

By adapting the "Noscru" principle the "Sarco" company makes a canopy switch which is a real novelty and an entire bracket can be controlled by simply boring a 5/16-in. hole in the canopy, putting the

FIG. 2.—CANOPY SWITCH.

canopy switch in position, then fastening the nut tight, pushing the two wires through the holes and bending them over and replacing the cap—an operation that can be accomplished in ten seconds. Another

FIG. 3.—"NOSCRU" KEY-ARM SWITCH.

variation of the same idea is in the "Noscru" key-arm switch, which is claimed to be the smallest key-arm switch in the world, it being only one inch in diameter. This key-arm switch instantly makes direct contact on the wires and cannot short-circuit or ground, as all of the working parts are surrounded by porcelain, and underwriters approve nothing else.

Another of the Sarco specialties is known as a "Cast-iron Cinch" in the form of an outlet box. This box was specially designed to meet the latest requirements of the National Code rules, and takes a minimum of time to install as well as exemplifies the best class of workmanship. Styles are made for use with armored cable, and in addition it can be used as a junction box, in every way giving adequate satisfaction.

Fort Wayne Series Alternating Street Arc Lighting System.

The Fort Wayne series alternating-current system of street arc lighting consists in common with other alternating series arc lighting systems of a combination of a constant-current regulator and a number of arc lamps connected in series. The system includes the use of a Wood regulator mechanically different from any others on the market, and form "C" Wood arc lamps specially designed for this service.

The automatic regulator consists of an E-shaped laminated iron core and a reactance coil surrounding the center leg of the core. The coil and core are hung on levers supported on knife edges in such manner that they counterbalance each other, both being movable. The levers are so arranged that the coil moves over the greater portion of the distance, being required to lift the core only through a short distance.

The regulator coil is connected in series with the arc lamp circuit. The regulation is automatic, any change in the resistance of the arc lamp circuit tending to produce a corresponding change in the current in the circuit, since the line voltage remains constant. But any change in the current changes the relative position of the core and coil, an increasing current bringing them closer together, a decreasing current allowing them to move further apart.

As the core enters the coil when they approach each other due to an increase in current, the additional reactance caused by the magnetic condition thus created serves to counteract the decreasing resistance of the line and creates such an impedance that the current remains constant. Any decrease in the load tends to increase the current and draws the coil and core together, thus increasing the impedance in the circuit; while any increase in the load tends to decrease the current and allows the core and coil to separate, thus decreasing the impedance in the circuit. The result is that the current is maintained at its normal value automatically. So perfect are the mechanical construction and electrical proportions of the regulator that the load may be reduced gradually from full load to no load until the regulator is directly across the line in short-circuit without causing any marked change in the current. The load may also be changed from full load to short-circuit with but momentary current variation. This insures perfect protection to the system

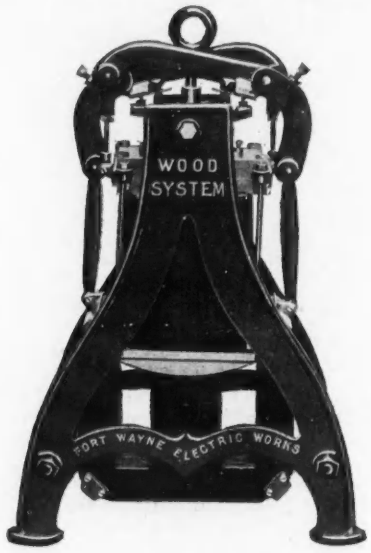


FIG. 1.—REGULATOR.

against short-circuits due to failure of insulation of the outside lighting circuit.

When this regulator is intended for use on a small system of 25 lights or less, the lighting system may be connected directly to the machine circuit without the use of transformers. When, however, it is necessary to install the system on a machine supplying other circuits, a transformer is recommended. This transformer is connected between the machine and the series arc regulator circuit, thus insuring perfect separation of its circuit from any others supplied from the same machine. Transformers for this use are furnished of one-to-one ratio, or if higher voltages are required with the proper ratio to obtain the desired voltage for the arc circuit.

It is frequently necessary in installing arc lighting systems to con-

sider extensions of the system to meet the growth of the community. The Fort Wayne series alternating system is designed to take care of extensions and at the same time to operate efficiently with the initial load. This is done by installing a regulator large enough to meet the maximum future demands and a transformer furnishing proper voltage to economically operate the regulator with this partial initial load. This lower voltage is obtained from a series of secondary taps, by means of which the arc circuit voltage may be varied

FIG. 2.—REGULATOR.

from 50 per cent. of full voltage up to maximum secondary voltage in steps of such value that the circuit will always be working at approximately full load efficiency. This method of transformation will allow a lighting plant to practically double its series arc lighting output without any increase in the regulating system or transformer, simply by changing the connections on the secondary taps of the transformer; and at all times it insures the highest economy and maximum power factor in the regulator circuit.

Figs. 1 and 2 show the Wood regulator mounted on a stand for station installation. The knife edges are mounted on a casting supported on two A-frames, between which the regulator is suspended. The joints in the levers furnish means for adjusting the regulator for the proper current.

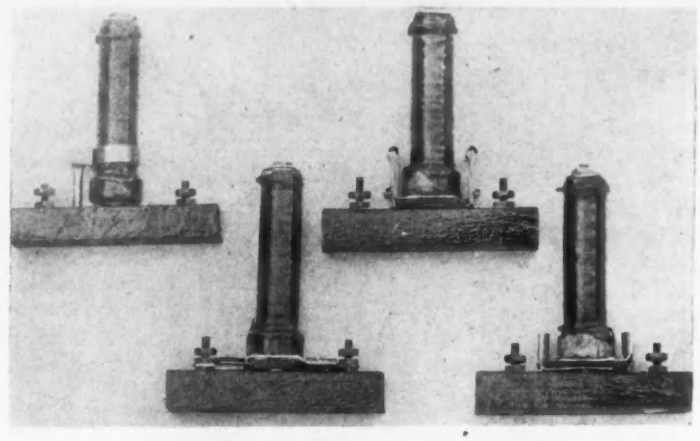
Gas Power Plant Extension.

A gas engine power plant which has attracted considerable notice within the last few years is that of the Union Switch & Signal Company, Swissvale, Pa. This plant at present contains 500 brake hp in Westinghouse three-cylinder vertical gas engines of the direct-connected type. The generators are of 220 volts, alternating current, and operate in parallel upon a common bus, with a widely fluctuating load due to manufacturing operations in the works of the company, for which power is furnished by the plant.

On account of the successful operation of the gas engine plant up to the present time, the Union Switch & Signal Company has decided to increase its capacity, and for that purpose has contracted with the Westinghouse Machine Company for a 300-hp horizontal double-acting engine of the type introduced in 1902 by the Westinghouse Machine Company. It has two cylinders 16½ in. in diameter, 24-in. stroke, arranged in tandem with single crank. The engine will drive a 210-kw Westinghouse alternator which will operate in parallel with the four generators now installed and furnishing 220-volt, two-phase, 60-cycle current for power and lighting throughout the works. The unit, which operates at the speed of 180 r.p.m., has an extended shaft for the reception of a pulley driving a small exciter generator. When the new plant is completed steam will be entirely dispensed with except for heating buildings and running steam hammers and riveters.

Interchangeable Enamel Resistance Units.

As there has been a considerable demand for enamelled resistance units so arranged that they can be conveniently mounted upon panels, switchboards, etc., being so designed that they are readily interchangeable, the Ward Leonard Electric Company, of Bronxville, New York, has designed and perfected the method of mounting

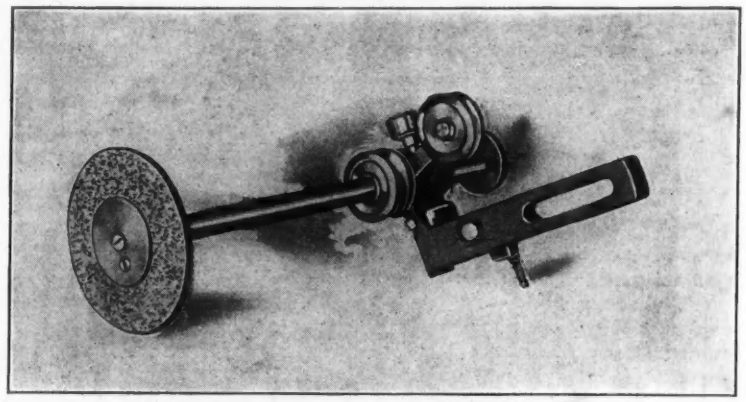


INTERCHANGEABLE RESISTANCES.

shown in the cut. The cut shows B size unit, but any of its different sized tubes can be arranged in the same manner. The tubes can be taken from the bases by hand without use of any tools—just as readily as panel cartridge fuses are removed. Different units of greater or lesser resistance can be used to replace each other and any desired result may be obtained. The Ward Leonard Company has sold over 2,000,000 of its enamelled resistance tubes (having the resistance wire hermetically sealed from the atmosphere) during the last four years, and its engineers, are busy daily accommodating the trade with various improved methods of mounting these devices.

Truing Commutators.

How best and easiest to true up commutators is always a problem for the manager of a plant, and it is universally recognized that the most desirable and proper way is to do it without removing the



DEVICE FOR TRUING COMMUTATORS.

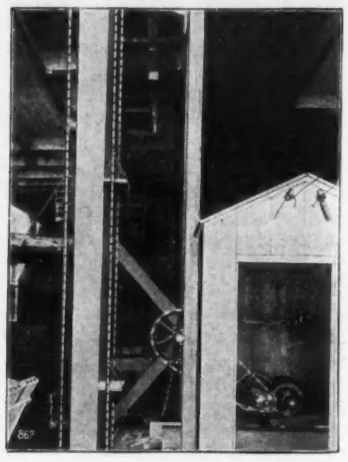
armature from the dynamo or motor needing attention. The device here shown is, as will be seen, very simple, and can be applied to the average machine without any trouble or difficulty. Its use avoids the necessity of removing the armature and placing it in the lathe, and also obviates the danger due to the use of diamond point tools, by digging into a commutator already in bad shape. When the work is done, the commutator is smooth and true. The apparatus is made by Jordan Bros., of 74 Beekman Street, New York City.

Massachusetts Technology at Niagara.

The Western alumni of Massachusetts Institute of Technology will go by special train to their great reunion at Boston this month and a visit to the electrical industries at Niagara Falls is to be given a day of the time en route.

Motor-Driven Contractor's Hoist.

As an indication of the economy of electric motor drive in industries temporary in character and also the adaptability of Northern direct-current apparatus the illustration below is of interest. The equipment shown was installed by a contractor in a metropolitan city, to do away with the cost of installing steam hoisting for the transportation of material required in finishing a building. The cost of current for this work, in this instance, was 50 cents per day, as against a charge of $2.50 to $3.00 per day wages for an engineer for



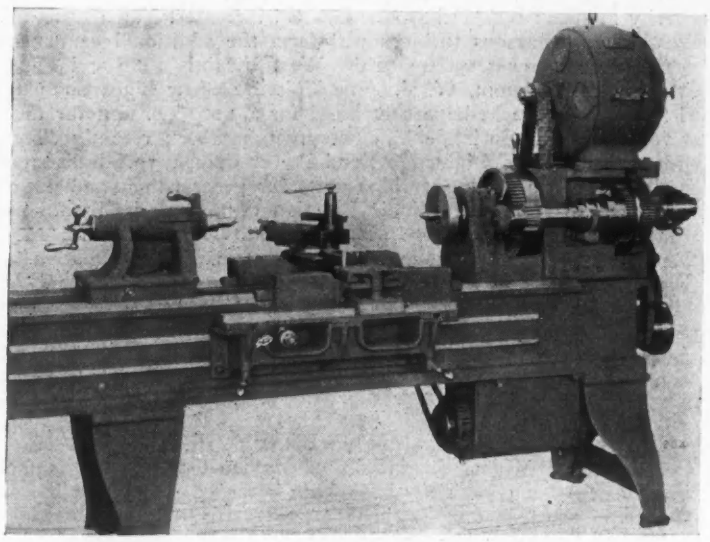
TEMPORARY ELECTRIC HOIST.

a steam hoist, as well as the cost of several hundred pounds of coal consumed each day by the steam equipment.

The motor used is a Northern back-geared motor built by the Northern Electrical Manufacturing Company, Madison, Wis. It is especially adapted to service of this nature owing to its great simplicity as well as rugged and simple character. The motor is a self-contained mechanism, the design and construction of which insures that motors operate with constant alignment of countershaft with armature pinion, thereby securing practically noiseless operation.

Motor-Driven 18-Inch Lathe.

While a great deal has been published recently illustrating and describing motor drives applied to standard machine tools, constant progress is being made in the designing of new tools to accommodate motor drives and in the modification of old tools for the same purpose. One of these latter instances is illustrated herewith, showing an 18-in. Le Blond screw-cutting lathe driven by a shunt-wound



MOTOR-DRIVEN LATHE.

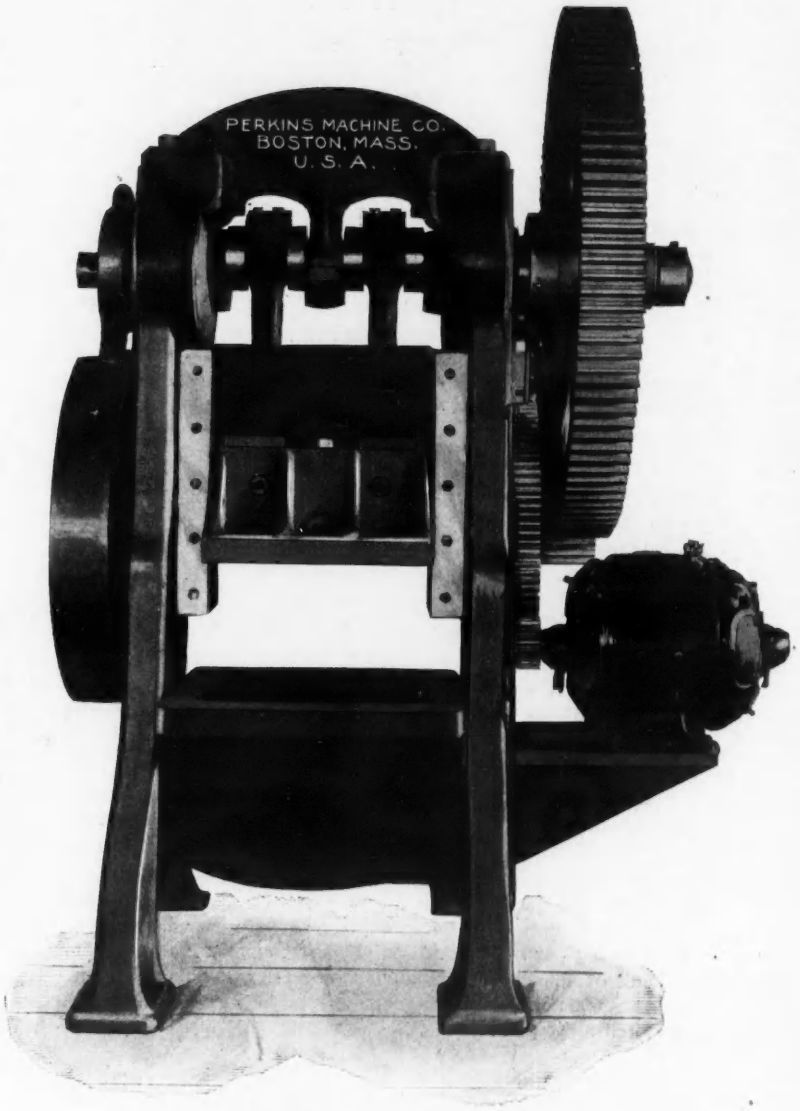
Crocker-Wheeler motor. The motor is supported on a special housing and the drive is by means of a Morse silent chain from the motor shaft to the main lathe spindle. The speed control is accomplished by the multiple system of the Crocker-Wheeler Company, using in this case a controller giving a range of twenty-one speeds. Only a portion of this range is used as working speeds, the entire range of the tool being increased by a double back-gear attachment which permits a total speed range of from 410 r.p.m. of the spindle to 5.75 r.p.m.

With this entire range three runs of gearing are provided, one being direct and the other two through back gears. Each of these various runs is controlled by a friction clutch, the lever for operating which is located in front of the head stock. About 40 speeds are provided with 2.8 hp, available at any speed between 20 and 410 r.p.m. of the spindle. For the heaviest working range of the tool, however, namely, 28 to 124 r.p.m., 3.4 hp is available.

The whole equipment is well laid out, the speed changes are accomplished quickly and easily, and the strength of the motor and gearing is sufficient to accommodate cutting speeds in cast iron and soft steel of 70 ft. per minute. One prominent feature of the Crocker-Wheeler multiple-voltage system is that it affords speeds to use these high cutting speeds properly, and gives ample power at all speeds without an excessively large motor.

Electrically-Driven Machine Tools.

One of the machine tools built recently by the Perkins Machine Company, of Warren, Mass., for the United States Government is herewith illustrated. It is driven by a fully enclosed 10-hp General Electric motor. The machine weighs 18,000 pounds, and has an 8-in.



MOTOR-DRIVEN PRESS.

main shaft bearing. The gear is 60 in. in diameter and weighs 1,800 pounds. Its teeth are cut in the solid metal. The adjustment of the pitmans is very accurate; and by simply turning an internal gear both pitmans are operated at the same time.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was exceedingly dull and trading was conducted on a very restricted basis, although there was a moderately firm tone. There were no features of importance, but the steadiness of the bond list and the demand for investment securities attracted attention. The United States Steel issues held firm at a moderate decline, notwithstanding the unfavorable reports of the iron trade. In the traction list Brooklyn Rapid Transit developed strength on favorable reports as to earnings and summer business outlook. Reports continue of the settlement of the litigation between the Amalgamated Copper Company and the Heinze interest, but the manipulation of the former was not of a very confident character. The industrial list as a whole was very quiet. Allis-Chalmers common closed at 7, being a net gain of 1 point; General Electric at 156, a gain of 1 point and Westinghouse Common 156, a net loss of ⅛ point. In the traction list Brooklyn Rapid Transit closed at 47½, a gain of 1½ point, and Metropolitan Street Railway at 110, a loss of 1 point. Western Union is off ¼ point, closing at 87. The curb market was very dull, and the volume of transactions was much decreased. Following are the closing quotations of May 31:

NEW YORK.

	May 24	May 31		May 24	May 31
Allis-Chalmers Co.	6⅛	7⅛	Electric Vehicle	5⅛	6⅜
Allis-Chalmers Co. pfd.	39⅛	40	Electric Vehicle pfd	9	9¼
American Tel. & Cable	87	86¾	General Electric	156	155¼
American Tel. & Tel.	125	125	Hudson River Tel.	..	..
American Dist. Tel	22	22	Metropolitan St. Ry.	110⅛	109⅛
Brooklyn Rapid Transit	46⅞	46⅞	N. Y. & N. J. Tel.	..	..
Commercial Cable	180	180	Marconi Tel.	..	..
Electric Boat	25	25	Western Union Tel.	86⅛	85¾
Electric Boat pfd.	60	60	Westinghouse com.	155	154⅛
Electric Lead Reduction	⅝	⅝	Westinghouse pfd.	180	180

BOSTON.

	May 24	May 31		May 24	May 31
American Tel. & Tel	125	125	Western Tel. & Tel. pfd.	77	77
Cumberland Telephone	113	112¾	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	234	234	New England Telephone	*121¾	121
General Electric	155	154	Mass. Elec. Ry.	18	18
Western Tel. & Tel.	*7	*7	Mass. Elec. Ry. pfd.	70⅛	72

PHILADELPHIA.

	May 24	May 31		May 24	May 31
American Railways	44⅛	44	Phila. Traction	95¾	95¾
Elec. Storage battery	55	55	Phila. Electric	5⅛	5⅛
Elec. Storage Battery pfd.	55	55	Phila. Rapid Trans.	12¾	12¼
Elec. Co. of America.	8	8⅛			

CHICAGO

	May 24	May 31		May 24	May 31
Central Union Tel.	..	..	National Carbon pfd.	101¾	101¾
Chicago Edison	..	..	Metropolitan Elev. com.	16	18
Chicago City Ry.	156	165	Union Traction	5⅛	6
Chicago Tel. Co.	..	..	Union Traction pfd.	29	29
National Carbon	29	29			

*Asked

MONTREAL LIGHT, HEAT AND POWER.—The annual statement of the Montreal Light, Heat and Power Company will show gross earnings for the year to be $2,589,000, as compared with $1,937,000 for the previous twelve months. The net revenue after deducting interest on bonds, fixed charges, and a large sum to make good the washing away of the dam at Chambly, amounts to $900,000, or 5¼ per cent. on the capital stock. The bonded indebtedness of this company, nearly $17,000,000, and bearing interest at the rate of 4½ per cent. and 5 per cent. is largely owned in New York and Boston. President H. S. Holt, in his annual report, says: "The increase in net profits for the year amounted to $165,346, notwithstanding the fact that in the gas department there was paid $61,000 additional for coal used, also an increase in wages in both gas and electrical departments of 20 per cent. There were issued during the year $16,000,000 5 per cent. bonds to pay for construction and redemption of bonds of subsidiary companies. The increase in the output of gas was 52,905,000 cubic feet (6 per cent.). The increase of shareholders amounted to 50 per cent."

LOCKPORT, N. Y., POWER ENTERPRISE.—It is reported that the Niagara, Lockport and Ontario Power Company, which is building the canal power from the Niagara River, will also submit a contract to the city to furnish Lockport with water at two cents per thousand gallons. The company agrees to deliver water by 1906. The low rate is offered to give the power company the right to eminent domain, which is considered to be in doubt.

Commercial Intelligence.

THE WEEK IN TRADE.—The better weather has improved distributive trade in some sections, but the situation as a whole is more irregular, and trade is behind that of a year ago. Cereal crops, especially winter wheat, show improvement, but cotton reflects droughty conditions in the South Atlantic and Gulf states, while good reports come from west of the Mississippi. The industrial situation is not so satisfactory, a slowing down being noted in many industries. Current railway earnings are still on the decline from a year ago; clearings are running smaller, and prices tend downward. In the iron trade, finished products are rather quieter. Orders for 1,000 cars are reported placed at Chicago. At Pittsburg the iron trade is lifeless and milling operations are irregular. There is a congestion of soft coal at lake shipping points owing to the suspension of the up-lake transportation. Some concerns are buying in the open market, finding it cheaper to do so than to operate their own mines. Anthracite is in good demand. The railroads are laying off large numbers of men, the services of at least 30,000, it is said, having been discontinued since the first of the year. The strike on the Lakes is tying up the ore and coal traffic, rendering idle many thousand of ore and coal miners, and others. The labor situation is generally unsettled. Among the metals copper was very dull and weak, and prices have again been reduced. Lake is quoted at 13c @ 13⅛c; electrolytic, 12¾c @ 13c, and casting stock 12½c @ 12¾c. The exports thus far this month have aggregated 11,186 tons. It is estimated that at the end of May the exportation will amount to about 13,000 tons, which, while being large in comparison with the figures of a year ago, will show a decrease as compared to the extraordinary shipments of the last few months. *Bradstreet's* reports the number of business failures for the week ending May 26th as 184, against 215 the previous week and 181 the corresponding week last year.

PROGRESS IN STEAM TURBINES.—It has already been announced that the immense power station of the Pennsylvania, New York and Long Island Railroad, and the Philadelphia Rapid Transit Subway system of Philadelphia are being equipped with steam turbines aggregating at the start 33,000 kw. capacity; but of more immediate interest is the fact that the Interborough Rapid Transit Company of New York and the Brooklyn Rapid Transit system have both adopted steam turbines of the Westinghouse-Parsons type for extensions in power. The equipment of these systems will be in units of 5,500 kw. each, thus conforming to the precedent established by the Pennsylvania and Philadelphia systems in regard to the capacity of their largest main generating units. The Philadelphia Rapid Transit Company have also recently extended their original order for 16,500 kw. in Westinghouse-Parsons turbines by 6,000 kw. in four units of 1,500 kw. each. In the electric light and power field, the activity in steam turbine introduction still increases. Two 1,000-kw. Westinghouse-Parsons turbines will form the additional equipment to the present power system of the West Virginia Pulp and Paper Company at Piedmont, W. V. The United Electric Light Company of Springfield, Mass., have contracted for a 1,000-kw. unit for their power station at Springfield. A contract has been recently closed with the Merchants' Light, Heat and Power Company of Indianapolis, Ind., for two 750-kw. turbine units for general light and power service. The Iowa and Illinois Traction Company of Clinton, Ia., will shortly install two 400-kw. turbine units for furnishing additional power to their present railway system. An installation of peculiar interest as being the first to be placed in service in American mining work will be that of the Newhouse Mines and Smelter Company, who will install two 400-kw. units at their Cactus Mines, near Frisco, Utah. Turbines will furnish electric power for lighting the buildings and mines, and for all kinds of power throughout the entire property.

EXTENSIVE MEXICAN POWER PROJECTS.—Jose Maria Volasquez and Miguel S. Macedo, of Mexico City, the first named being a prominent engineer, have been accorded permission by the Mexican Government to establish an extensive electric power and irrigation system in the Iguala district, State of Guerrero. The waters of the Tuxpam, Lagoon, Amates and Tubpam rivers will be utilized. They have also applied for the necessary concession from the Mexican authorities in order to use 20,000 liters of water per second from the Tomatal River, State of Guerrero to operate an hydraulic plant for lighting purposes principally.

EXPORTS OF MANUFACTURERS in the fiscal year which ends with this month seem likely to exceed those of any preceding year. Ten months' figures just presented by the Department of Commerce and Labor through its Bureau of Statistics exceed those for the corresponding period of any preceding year. The fiscal year 1900 was the banner year in exports of manufactures, but the figures of ten months' exports of manufactures in the fiscal year 1904 exceed by nineteen million dollars those for the corresponding months of the fiscal year 1900. The total value of manufactures exported in the ten months ending with April, 1904, was $371,712,301, against $352,671,206 in the same period of the fiscal year 1900, which, as already indicated, made the highest record of manufactures exported prior to the fiscal year 1904. The fact that the present fiscal year has only two months' record to make and is nineteen millions ahead of the highest figure for the corresponding period in any preceding year (1900) seems to justify the prediction that the exports of manufactures in 1904 will be greater than those of any earlier year. The total value of manufactures exported in the full fiscal year 1900 was $433,851,756. Should the present excess of 1904 over 1900 continue during the remaining two months of the year it would bring the grand total of exports of manufactures up to $450,000,000. The export of manufactured products in ten months in 1894 was $153,466,065 or less than half what it is now.

THE STERLING COMPANY is building switchboards and additional switchboard equipment for Newark, Ohio; Francesville, Ind.; Janesville, Wis.; Waverly, Ohio; Flat Rock, Ill.; Broadhead, Wis.; Austinburg, Ohio; Newton, Ill.; Carson City, Mich. It is also furnishing its various types of combined cross connecting rack and protectors at Newark, Ohio; Centerburg, Ohio; Gambier, Ohio; Wilkshire, Ohio; Baltimore, Md.; Sheboygan, Wis.; Danville, Ill.; Lebanon, Ind.; Cleveland, Ohio; Wayne, Neb.; Coschocton, Ohio; Donora, Pa.; Louisville, Ky.; Ardmore, I. T.; Portland, Me.; Dexter, Mich, and Wessington Springs, S. D. The company has secured the contract to furnish the Standard Oil Company, of Albany, N. Y., with one of its latest type of private branch switchboards, and it is now manufacturing a 5,000-capacity, 1,200-line multiple switchboard for the Home Telephone Company, at Tiffin, Ohio. This board is to be its new type of lamp signal magneto switchboard and will be among the first lamp signal multiple switchboards installed in the United States. The Sterling Company is, besides the above, furnishing additions and switchboard equipment for the following cities: St. John, Wash.; Wessington Springs, S. D.; Hamilton, Mo.; Chardon, Ohio; Roanoke, Va.; Johnson City, Ill.; Indianapolis, Ind.; Lorain, Ohio; Des Moines, Ia.; Hoopeston, Ill. They are also furnishing its different types of protector apparatus for the following cities: Warren, Pa.; St. Louis, Mo.; Spirit Lake, Ia.; Alexandria, Ohio; Butler, Pa.; Tampa, Fla.; Johnstown, Pa.; Chardon, Ohio; Pittsburg, Pa.; Sedalia, Mo.; Flushing, Ohio; Buckley, Ill.; Kansas City, Mo.; Superior, Wis.; New Bremen, Ohio; Utica, N. Y.

SOME C. & C. ORDERS.—The C. & C. Electric Company, 143 Liberty street, has secured a Canadian contract for nine motors varying in capacity from 5 hp. to 10 hp. to drive Hoe presses by means of Renold chains in a large Toronto lithographic plant. Various domestic orders have been received recently from Maryland, New Jersey, Pennsylvania and New York. The demand has been particularly good for small motors. The Baltimore *Sun* plant is to have two 35-hp. series parallel equipments for driving Hoe quadruple presses. The International Phosphate Company, of Cartaret, N. J., has ordered another 50-kw. belted generator. The Mauch Chunk (Pa.) Heat, Power and Electric Light Company has ordered twelve motors varying in size from 1 hp. to 10 hp. for its customers. A 50-kw. direct-connected generator has been ordered for the Brown Building, Wall Street. This is a repeat order. The engine will be Ball & Wood.

TURBINE PLANT FOR UNION METALLIC CARTRIDGE CO.—Westinghouse-Parsons steam turbines are to be installed in the new power station of the Union Metallic Cartridge Company at Bridgeport, Conn. The initial installation will consist of two turbo-generating units, each of 500 kw. capacity, to operate in parallel, and furnish 440-volt, 3-phase current at 60 cycles for general power and lighting purposes in the various shops located within three or four blocks of the power station. The turbines will operate under 150 pounds steam, 28 feet vacuum, and possibly superheat. The installation is in charge of Mr. Samuel M. Green, consulting engineer, Holyoke, Mass.

EQUIPMENT FOR MEXICAN COTTON MILLS.—The purchase is pending of a 750-hp. equipment for the water power plant of the Santa Gertrudes Cotton Mills, State of Orizaba, Mexico, owned by Sir Weetman D. Pearson. Mr. A. E. Worswick, formerly chief engineer of the Federal District Railway Company of Mexico City operating the Wernher Beit line, is now consulting electrical expert for the Pearson people, who have considerable electrical work in prospect in the Southern republic, notably in regard to the conversion of the Vera Cruz tramways, of which Sir Weetman is president. Mr. Worswick has his headquarters for the present in Mexico City.

WAGNER-BULLOCK APPARATUS.—The Washington and Oregon Water Power Company has closed contracts with the Wagner-Bullock Electric Company for three 500-kw., 3-phase Bullock generators to furnish power to operate their electric road and lighting business in the country surrounding Walla Walla, Wash. The power station will probably be located at Milton. There will be sub-stations at that point and also at Pendleton and Walla Walla.

MEXICAN ELECTRIC RAILWAY PROJECT.—An electric railway is to be constructed between Puebla Nueva and Navidad del Puerto, in the State of Jalisco, Mexico, the first port north of Manzanillo on the Pacific slope. The line will be built by the owners of the Puebla Nueva mines, who are European capitalists. The material, equipment, etc., will be practically all purchased in the United States. The road will develop considerable contiguous territory.

VERA CRUZ POWER TRANSMISSION.—Mexican advices state that Antonio A. Moll is primarily interested in a scheme to utilize the waters of the River Ozolonpam, in the Canton of Acayucan, southern part of the State of Vera Cruz, for generating electric energy for transmission to various plantations operated by Americans in that part of the world. Mr. Moll proposes to make use of 10,000 liters of water per second.

GERMAN-AMERICAN CABLE.—We are advised by Felten & Guillcaume, of Mulheim on Rhine, that the new German-American cable on the cable steamer "Stephan" recently in port at New York, was made by the company now laying it, viz., the North German Cable Works (Norddeutsche Seecabelwerke Actiengesellschaft) of Nordenham, Germany, which is under the technical direction of the firm first named.

GREAT NORTHERN POWER PLANT.—The Great Northern Power Company, Duluth, Minn., are to instal vertical turbines and other apparatus to operate at 250 revolutions per minute under a head of 365 feet. It is proposed to have a 35,000 hp. plant in operation in 1905. The plans provide for an increase in capacity up to 80,000 hp. Another hydraulic installation of 12,000 hp. at a 70-foot dam is also proposed.

EQUIPMENT FOR NEW MAIDEN LANE BUILDING.—Percival Robert Moses, consulting engineer, 35 Nassau street, will draw up the plans and let the contracts for the equipment to be installed for light and power purposes in the twelve-story office building to be erected at 48-50 Maiden Lane, New York, by Mr. S. F. Myers, of that address.

LIGHTING OUTFIT FOR AUSTRALIA.—The engineering and contracting firm of Mackenzie, Quarrier & Ferguson, 114 Liberty street, has secured an export order for a 60-hp Harrisburg standard engine to be direct connected to a 35-kw. Western Electric generator. The equipment is to be shipped to Australia for lighting purposes.

POWER EQUIPMENT ORDERED FOR GUADALAJARA MINES.—Westinghouse generators and Pelton wheels are to be installed in a plant on the Thomas River, Territory of Tepic, Western Mexico. The power is to be used for operating the Central Mining Company's mines located in the Guadalajara district.

EQUIPMENT FOR BATTLESHIP INDIANA.—The U. S. battleship Indiana now being overhauled at the Brooklyn Navy Yard is to be equipped with three 100-kw. C. & C. generators direct connected to Forbes engines of 150-hp. capacity each. This equipment is to be used chiefly for lighting purposes.

MORE LIGHTING EQUIPMENT FOR VERA CRUZ.—The lighting system in Vera Cruz, Mexico, is to be increased. The contract is held on behalf of the original concessionaries' estate by Francisco Hernandez. An additional 500 kilowatt equipment will be installed in the power house.

DURANGO LIGHT AND POWER SCHEME.—Miguel Morga, of Yopia, State of Durango, Mexico, has applied to the Mexican Government for a concession which will permit of the utilization of the waters of the Sobrices River for operating a large electric light and power plant which he will build.

EQUIPMENT FOR MEXICAN SUGAR PLANT.—The Eastwick Engineering Company, Limited, of 42 Broadway, has secured a contract for the construction of a 1,000-ton sugar plant in Mexico, which will be installed with considerable electrical equipment for light and power purposes.

CHIHUAHAN LIGHT AND POWER PROJECT.—An extensive electric light and power plant is to be built at Guaynopita, State of Chihuahua, Mexico. The current will be generated by water power. Mr. J. W. Taylor, of El Paso, Texas, is primarily concerned in the enterprise.

CONDENSERS FOR TOKIO PLANT.—The Wheeler Condenser and Engineering Company, 42 Broadway, has secured a substantial contract for condensing equipment to be installed in the power station of the Tokio (Japan) Street Railway Company.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electrochemical Society. Secretary S. S. Stadtler, 39 S. 10th St., Philadelphia. Next meeting, St. Louis, Sept. 12-17, 1904.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, St. Louis, Sept. 13, 1904.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit. Mich.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, Oct. 4, 1904.

American Street Railway Association. Secretary, T. C. Pennington, 2020 State Street, Chicago. Next meeting St. Louis, Mo., Oct. 12 and 13, 1904.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, New York City and Portland, Ore.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Indianapolis, Ind., June 15 and 16, 1904.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., June 15, 16 and 17, 1904.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col. Annual meeting last Wednesday in October.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

Engine Builders' Association of the United States. Secretary, D. Fleming, Harrisburg, Pa.

Electrical Contractors' Association of New York State. Secretary, F. Fish, Rochester, N. Y. Next meeting, Utica, July 19, 1904.

Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electric Association. Secretary, H. E. Chubbuck, LaSalle, Ill.

Indiana Independent Mutual Telephone Association. Next meeting, Lafayette, June 28 and 29, 1904.

Indiana Public Utilities Association. Secretary, A. M. Barron, South Bend, Ind. Next meeting, Indianapolis, Ind., Oct. 18, 1904.

Independent Telephone Association of the United States of America. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago. Next meeting, St. Louis, Sept., 1904.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Pichardt, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, St. Louis, Sept. 13 and 14, 1904.

International Electrical Congress. General secretary, Dr. A. E. Kennelly, Cambridge, Mass. Meeting, St. Louis, Sept. 12-17, 1904.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky.

Iowa Electrical Association. Secretary, W. S. Porter, Eldora, Ia. Next meeting, Dubuque, Ia., April, 1905.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Ia. Next meeting, second Tuesday, March, 1905.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ind.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind. Next meeting, St. Louis, July, 1904.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, St. Louis, Mo., September 14, 15 and 16, 1904.

National Electric Light Association. Secretary, Dudley Farrand, Newark, N. J.

New England Street Railway Club. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, St. Louis, Sept., 1904.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Sandusky, Ohio, Aug. 16, 17 and 18, 1904.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, C. J. Miller, Canton, Ohio.

Pacific Coast Electric Transmission Association. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal. Next annual meeting June 21, 1904.

Southwestern Electrical Association. Secretary, J. L. Ellis, Oklahoma City, Okla.

Southwestern Gas, Electric & Street Railway Association. Secretary, Frank E. Scovill, Austin, Texas.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt. Next meeting, Montpelier, Sept. 21 and 22, 1904.

Western Society of Engineers, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

General News.

THE TELEPHONE.

MONTGOMERY, ALA.—The Eastern Shore Telephone Company has been incorporated at Fairhope.

BIRMINGHAM, ALA.—The Smith County Telephone Company has been incorporated with headquarters at Taylorville. The capital stock is $30,000.

RED BLUFF, CAL.—The Red Bluff & Paskenta Telephone Company has been incorporated, the capital stock being $5000. The incorporators are Albert, R. O. Snelling, E. D. Gardner and others.

SAN LUIS OBISPO, CAL.—The Sunset Telephone Company is rebuilding its entire system in this place involving an expenditure of about $20,000. A new multiple, central-energy switchboard will be installed in the exchange in place of the old-fashioned one now in use.

BOISE, IDA.—The Grangeville & Salmon River Telephone Company has been incorporated with a capital stock of $12,000. The directors are L. Hollingshead, J. O. Levander and others.

MANLIUS, ILL.—The Bureau County Mutual Telephone Company has increased its capital from $2500 to $20,000.

SAVANNAH, ILL.—The Carroll County Independent Telephone Company has increased its capital from $75,000 to $150,000.

ASSUMPTION, ILL.—The Assumption Telephone Company has been incorporated with a capital stock of $2400. The directors are S. S. Shafer, S. J. Long and others.

DELPHI, IND.—The Flora Bringhurst Telephone Company has been organized with W. G. Calene as president.

BLOOMFIELD, IND.—The New Home Telephone Company has authorized the issue of $100,000 preferred stock.

SEELEYVILLE, IND.—The Loss Creek Mutual Telephone Company has been incorporated with a capital stock of $3500. F. H. Felling, F. Conoway and M. Modesitt are directors.

EVANSVILLE, IND.—A resolution was introduced in the council at its last meeting that no action be taken on the telephone franchise question until the court's decision is handed down. This means that the Cumberland Company's claim must be removed before the franchise can be let to advantage—which means to the highest bidder.

COLUMBUS, IND.—The rivalry between the Hope and the Hartsville Telephone Companies is now at an end. Formerly each town had an exchange and the Hope line, owned by Frank Bowman, ran to Hartsville and the Hartsville line owned by A. J. Cottle, ran to Hope, Mr. Bowman has purchased the Hartsville line, and the two have been consolidated.

EVANSVILLE, IND.—The "Anti-Monopoly Telephone Company" has been organized in this city by manufacturers with a capital stock of $500,000. The company will ask for a 30-year franchise in a few days and will agree to pay the city a bonus of $125,000 in that time. The following well-known manufacturers were elected officers: B. F. Von Behren, president; R. Manheimer, vice-president; Henry Cook, secretary; E. Lyon, trasurer; A. L. Flickner, Joseph Kohlmeyer, E. Wile, W. S. Flickner and Fred Elmendorf, directors.

EVANSVILLE, IND.—In a meeting held here it developed that the way in which the Citizens' Telephone Company is to pay the debts of the old municipal scheme is through the purchase of the plans of the latter company. For a year employees were at work on plans for the plant to be installed by the municipal company. These are now held to be the chief assets and it is believed they can be sold for a sum sufficient to wipe out the indebtedness, and of course the only company that would need them would be the new concern coming into the field.

INDIANAPOLIS, IND.—The telephone capitalists from Pennsylvania and Ohio, headed by J. G. Splane, of Pittsburg, who have been inspecting the independent plants in the middle west and perfecting plans whereby an independent long-distance line from St. Louis to the Atlantic coast is to be constructed spent two days in Indianapolis inspecting the exchanges of the Indianapolis company and conferring with the officers of the New Long-Distance Telephone Company. Mr. Splane said that the arrangements had been completed and that the service would be given to the people as soon as a few short connecting lines can be constructed. He said no separate company will be capitalized for the long-distance line, but each of the large companies will construct and control the lines in its territory. The New Long-Distance Company will complete the lines in Indiana, the Kinloch in Illinois and Missouri, the United States in Ohio, the Independent Long-Distance Telephone & Telegraph Company of Louisville in Kentucky, and the Western Company in Kansas and Missouri. The plan of operation will be similar to the traffic arrangements between the railroads of the country.

WEBSTER CITY, IA.—The E. H. Martin Telephone Company has bought $10,000 worth of telephone cable from the Stromberg-Carlson Company.

KEOKUK, IA.—The Iowa Telephone Company will soon construct conduits for the wires in the downtown district. A site has been purchased for a new exchange building.

FRANKFORT, KY.—The Brandenburg & Big Bend Telephone Company, of Meade County, has filed articles of incorporation with a capital stock of $1050. The principal stockholders are S. B. Crecelius, William Green and M. J. Bennett.

EASTON, MD.—The Cecil Farmers' Telephone Company has been granted a charter to operate a system in Cecil County.

BANCROFT, MINN.—A new telephone company has been organized here with A. H. Henry as president.

ST. PETER, MINN.—Farmers of Lake Prairie and Lavasse have formed a company to build 18 miles of rural telephone line.

BILLINGS, MO.—The Billings Telephone Company has been incorporated with a capital stock of $10,000. The directors are J. Schmill, C. A. Dewitt and others.

ST. LOUIS, MO.—Financial arrangements have been completed by the Kinloch Long Distance Telephone Company of Missouri with a St. Louis banking syndicate whereby it, together with other leading independent companies of the country, will be enabled to perfect a trans-continental long-distance system. The Kinloch Company will shortly file a first mortgage deed of trust to the Mississippi Valley Trust Company, of St. Louis, trustee, covering all of the suburban and interurban properties embraced in the long distance service, to provide additional capital for extra outlays needed for additions, extensions and other like improvements. Rate agreements have been formed between all of the various independent telephone companies, situated between Pittsburg and Kansas City, whereby the service will be in operation within the next few months.

BILLINGS, MONT.—The Billings Mutual Telephone Company and the Montana Telephone Company, which will operate here and in eastern Montana, have filed articles of incorporation. The former has a capitalization of $40,000 and the latter $10,000.

WAYNE, NEB.—The Wayne Independent Telephone Company has filed articles of incorporation, the capitalization being $15,000. The officers are: President, Thomas H. Fritz, vice-president, Irving E. Huff; secretary, Frank E. Bell, and treasurer, Andrew N. Matheny.

CONCORD, N. H.—The Independent Telephone Company will install a system in Claremont, Newport and Sunapee.

ROCHESTER, N. Y.—The Hamlin Rural Telephone Company has filed articles of incorporation with a capital stock of $5000.

COOPERSTOWN, N. Y.—The Otsego Home Telephone Company has been incorporated with a capital stock of $40,000. F. C. and A. A. Ward are the directors.

GLENS FALLS, N. Y.—The stockholders of the new Union Telephone Company of this place have voted to consolidate with the Troy and Saratoga independent companies.

POTSDAM, N. Y.—The Northern Union Telephone & Telegraph Company has been incorporated with a capital stock of $50,000. The directors are A. B. Thompson and others.

ALBANY, N. Y.—The South Bethlehem Telephone Company has been incorporated with a capital stock of $2000 to establish a telephone line between South Bethlehem, Selkirk and Cedar Hill. The directors are E. C. Palmer, Charles D. Niver, J. R. Davidson, of South Bethlehem; Newton B. Vanderzee, John W. Mosher, John B. Mosher and John F. Vrooman, of Selkirk.

STRYKER, OHIO.—The Stryker Telephone Company has increased its capital from $10,000 to $15,000.

CLEVELAND, OHIO.—The Citizens' Telephone Company, of Cleveland, has increased its capital stock from $40,000 to $50,000. Mr. H. W. Bolles is president.

OTTAWA, OHIO.—The Ottawa Mutual Telephone Company has been incorporated with a capital stock of $1000 by C. O. Beardsley, J. H. Purnell, F. E. Smith, E. L. Tapper and George Fritz.

SUMMERFIELD, OHIO.—The Summerfield Telephone Company has been incorporated with a capital stock of $5000. The directors of the company are J. H. Sparling, William Simmons and others.

GILBERT, OHIO.—The Gilbert Telephone Company, with a capital stock of $2000, has been incorporated by E. L. Roe, Chalmer Menafee, H. L. Nye, J. B. Rhodes, W. M. Bateman and S. W. Winn.

COLUMBUS, OHIO.—The Alvordton Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are A. L. Bigelow, D. C. Lord, C. F. Poulson, P. C. Bigelow and V. E. Cunningham.

COLUMBUS, OHIO.—The Citizens' Telephone Company is extending its service and expects to install 4000 new telephones during the summer. The company expects to have its automatic switchboard installed the first of next year.

CINCINNATI, OHIO.—It is reported that a combination may be effected of all the independent telephone companies seeking to establish systems in Cincinnati, except the Queen City Telephone Company, whose application is now being heard in the Probate Court. The proposed combination will include the Interstate Telephone Company, the Fitzsimmons Telephone Company and the Cincinnati Telephone Company.

ORWELL, PA.—The People's Co-operative Telephone Company, of Orwell, has recently been organized with the following-named officers: President, E. D. Chaffee; vice-president, J. C. Petts; secretary, H. G. Newell; treasurer, E. B. Arnold.

COOKEVILLE, TENN.—The Gainesboro Telephone Company has petitioned for a franchise to establish an electric light plant in Cookeville.

GREEN BAY, VA.—The South Side Telephone Company has completed its line between this place and Farmville.

SPOKANE, WASH.—The Interstate Telephone Company contemplates building a line from this city to Harrison, Idaho, a distance of 200 miles.

OSHKOSH, WIS.—The Kirchhayne & Cedarburg Telephone Company, of Washington County, has increased its capital stock from $500 to $1500. Mr. William Tischerson is president, and W. P. Jocham, secretary.

PETERBORO, ONT.—The council for the city of Peterboro has granted to the Canadian Machine Telephone Company a ten years' franchise. The price for telephones must not exceed $15 per year for residences, and $20 per year for business. The wires and cables must be placed underground on the principal streets.

WALKERVILLE, ONT.—The town council of Walkerville has refused to renew the franchise of the Bell Telephone Company unless the company pays more money for its privilege. The town of Sandwich, Ont., some time ago also refused to renew its franchise to the company on precisely the same grounds.

ELECTRIC LIGHT AND POWER.

LEWISVILLE, ARK.—The Lewisville Light & Water Company, of Lewisville, has been incorporated. Capital, $25,000. E. B. Daniel is president, and G. W. Dobson, secretary.

LOS ANGELES, CAL.—John Johnson, Jr., representing Los Angeles parties, has asked for franchises for gas and electric plants at Oceanside and Escondido.

FRESNO, CAL.—The San Joaquim Power Company is figuring on two more water power plants in the mountains and additional steam capacity in Fresno of about 1500 kw. The company will also build an additional pole line to the power houses from Fresno, a distance of 36 or 40 miles.

SANTA CRUZ, CAL.—Articles of incorporation of the Watsonville Light & Power Company have been filed with the County Clerk. The stockholders are Fish M. Ray, Oakland; Joseph C. Love, Berkeley; David H. Foote, San Francisco; Charles W. Waller, San Francisco; A. W. Linforth, San Francisco.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Company will vote on June 15 on a proposition to create a bonded indebtedness of $4,000,000, to be secured by a deed of trust on all the properties of the corporation, which is the result of the recent consolidation of the Los Angeles Lighting Company and the Los Angeles Electric Company.

HARTFORD, CONN.—The Hartford Electric Light Company has secured the contract for lighting the city at $70 for each lamp per year for a period of 5 years.

KISSIMMEE, FLA.—The Kissimmee electric light plant will install a 120-hp engine and a dynamo of 1500 lights capacity.

TIFTON, GA.—The Tifton Ice & Power Company contemplates installing a large engine and dynamo in its plant at this place.

BLUE RIDGE, GA.—The Blue Ridge Electric Light & Power Company will enlarge its plant during the summer. Water power will be used for the operation of the plant.

WASHINGTON, GA.—It is expected that a 100-kw alternating current two-phase generator will be installed in the municipal electric light plant in this place. An electric pump will also be installed at the water works.

GRIFFIN, GA.—This town will issue $40,000 bonds in two or three months for the improvement of the electric light and power plant. Full information can be obtained by addressing J. M. Browner, Chairman of the Light, Water and Sewerage Commission.

GOLCONDA, ILL.—A franchise has been granted for an electric light plant, to cost $4000. J. O. Williamson is manager.

MT. VERNON, IND.—It is reported that the Mt. Vernon Electric Light Company will soon ask for bids for the construction of a plant.

ELKHART, IND.—The St. Joseph & Elkhart Power Company is said to be considering the extension of its system to Goshen, Laporte, Wakarusa and Syracuse.

MT. VERNON, IND.—The Mount Vernon Electric Light & Power Company has filed articles of incorporation with the Secretary of State. The capital stock is $15,000. R. D. Morris, G. V. Menzies and others are the incorporators.

WABASH, IND.—The Wabash Water & Light Company has incorporated with a capital stock of $160,000. Thos. W. McNamee, of Wabash, W. G. Snow, Montclair, N. J., and Edmond Le B. Gardner, of Ridgewood, N. J., are directors.

BOONEVILLE, IND.—The City Light & Power Company has been awarded the contract to light the city. The company's new plant will be pushed to completion. The contract accepted is liberal, in that it gives the city complete control, thus avoiding any possibility of excessive prices in the future. The city reserves the right to lease or purchase the plant at its option.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company will improve and enlarge its plant, increasing its capacity at least 150 per cent. The improvements will cost $250,000 or $300,000. The present powerhouse will be doubled in size and the new equipment will include 2500-hp, additional boiler capacity and two new Westinghouse turbine engines of 1150-hp each. The boilers will be equipped with the automatic chain grates.

WILTON, IA.—Bonds of $5250 have been voted to improve the electric light plant at this place.

DANVILLE, KY.—The City Council has decided to offer for sale a franchise to light this town by electricity.

CALDWELL, KY.—The Caldwell Electric Light & Power Company has been incorporated with a capital of $15,000.

STURGIS, KY.—J. M. Cartwright, Town Clerk, writes that the town would like some one to take a franchise and construct and operate an electric light plant here. The population is 1400.

BRANDON, MAN.—The Western Electric Light & Power Company, of Brandon, has been granted a charter. The company is to install an electric plant on the Assiniboine River, about 9 miles below Brandon. The capital of the company is fixed at $300,000, the provisional directors being J. M. Robinson, William Currie, William Alexander, B. Smith and John Russell, of Brandon. The company in the near future will establish a telephone system as well.

BALTIMORE, MD.—The Board of Awards has approved the specifications of the Electrical Commission for 1,000,000 feet of duct material and 250,000 feet of special duct pipe.

BALTIMORE, MD.—The Maryland Telephone & Telegraph Company has a force of men at work drawing cables through the conduits for the purpose of supplying electric light and power, the ordinance giving it this privilege having been passed and signed by the Mayor. At present the company will supply current from the Purnell plant, which it has purchased. The company intends to build a new central station at a cost of $1,500,000, and it is stated that it has options on waterfront property for this purpose.

MATTAPAN, BOSTON, MASS.—The Mattapan Gas & Electric Light Company, of Boston, has been incorporated, with a capital of $10,000. John H. Doherty is president.

EXCELSIOR, MINN.—Dr. F. B. Kramer has petitioned for a franchise for an electric light plant and water works.

BAY ST. LOUIS, MISS.—Mr. A. L. Stoker, owner of the electric light plant here, intends to put in a new engine and direct connected generator.

BATESVILLE, MISS.—The Panola Electric Light & Power Company contemplates building a line to Sardis at an early date, and lighting this town from the Sardis plant. The distance between the two places is nine miles.

SEDALIA, MO.—A charter has been granted the United Water, Gas and Electric Company, of Sedalia, with a capital of $1,000,000. The company has consolidated the Sedalia water, gas and electric companies.

ADDISON, N. Y.—The electric light plant owned by F. H. Wheaton was destroyed by fire May 13.

GRANVILLE, N. Y.—The Granville Gas & Electric Light Company is surveying for the construction of its dam at Lake St. Catherine.

HUNTER, N. Y.—The Tannersville Electric Light & Power Company has been organized with a capital of $20,000. Incorporators: Jacob Fromer, Geo. Haner, and Cyrus Showers, all of Tannersville.

KINGSTON, N. Y.—A corps of surveyors headed by Mr. Denman, of Ellenville, is engaged in locating the line for the poles and wires to bring electrical power from the Honk Falls power plant to this city for the Honk Falls Power Company.

ORRVILLE, OHIO.—The Orrville Light, Heat & Power Company will extend its street lighting system.

NEW CASTLE, PA.—The finance committee has recommended the issue of $85,000 bonds for a municipal electric light plant.

ELWOOD CITY, PA.—The Elwood Power Company contemplates establishing sub-stations at West Pittsburg and Zelenopile, and will complete 24 miles of high tension pole line.

MEMPHIS, TENN.—The North Arkansas Electric Railroad & Power Company, of Mount Hersey, Newton County, has filed articles of incorporation. Capital stock, $150,000, of which $30,000 has been subscribed. The officers are Griff Glover, Bloomfield, Mo., president; E. K. Eby, Jasper, Ark., vice-president; S. J. Norman, Jasper, secretary and treasurer.

DE LEON, TEX.—C. L. Rocker will install an electric light and power plant at De Leon.

NEW BRAUNFELS, TEX.—The Landa Electric Light & Power Company contemplates rebuilding one of its lines and otherwise improving its system at an early date. Mr. Louis A. Voigt is electrician.

BROWNSVILLE, TEX.—The city council of Brownsville has revoked the franchise which it granted several months ago to J. W. Macy, of Houston, for the establishment of an electric light plant and water works system here, and has granted a similar franchise to Judge James B. Wells, of Brownsville. Judge Wells says that he will soon commence the installation of the electric light and power plant and that he will also install a similar plant in Matamoros, Mexico, situated opposite Brownsville.

OGDEN, UTAH.—A recent electrical storm here caused damage to transformers and other machinery of the Utah Light & Railway Company to the extent of $15,000.

SALT LAKE CITY, UTAH.—The Gold Development Company has filed on the waters of Bullion canyon, as the first step towards the establishment of a power plant at that point.

OGDEN, UTAH.—It is reported that the Utah Light & Railway Company will establish a sub-station near the center of city for the betterment of electric lighting and power supply service.

SALT LAKE CITY, UTAH.—The Pan Power & Electric Company, of Utah, has been organized in Salt Lake City, with a capital of $10,000. Wm. D. Cameron is president; Jas. A. Mahon, secretary.

SALT LAKE CITY, UTAH.—The city council has under consideration a proposition submitted by Garff & Son, of Logan, Utah, to establish a large power plant here for the lighting of the city, with the understanding that in ten years the entire plant is to be deeded over to the city. The company estimated that $200,000 will cover the cost of the plant.

DANVILLE, VA.—A new electric light plant established by the municipality is now in operation and this place is now for the first time lighted by electricity. The plant is so arranged that it is possible to use either water or steam power alone or both together. The maximum capacity of the water power plant is 170-hp and this is reinforced by the steam plant, according to the requirements.

LADYSMITH, WIS.—The Ladysmith Light & Power Company contemplates the installation of series arc lights and the development of a water power.

MARSHFIELD, WIS.—R. L. Kraus is interested in forming a stock company to develop electric power at the dam of the Consolidated Water Power & Paper Company.

ST. MARYS, ONT.—The St. Marys Corporation expects to install new machinery next fall.

OTTAWA, ONT.—The city of Ottawa, some two years ago, voted for a civic lighting system, but at a recent meeting of the city council, in spite of the voice of the citizens, the Ottawa Electric Company was given a contract for street lighting for a period of ten years at $52 per light. Although this is a very favorable contract and a reduction of some $13 per lamp, yet there is much indignation manifested by the ratepayers that their wishes have been disregarded. The report of experts showed that the city could do its own lighting for $38 per lamp per year. Ottawa, therefore, stands to lose $80,000 over the ten years which the contract is to run.

THE ELECTRIC RAILWAY.

OPELIKA, ALA.—The organization of the Opelika Railway, Light & Power Company was effected a few days since by the election of the following officers: J. B. Green, president; Rush Taylor, first vice-president; Bartow Smith, second vice-president; W. C. Robinson, secretary and treasurer. The plan is to build an electric railway from Opelika to Auburn and furnish light and power for both places. The capital stock is to be $300,000.

ALTON, ILL.—The merger of the Alton Light & Traction Company and the Granite City Electric Street Railway Company has been effected. This will unite several hundred miles of street railway and will connect Alton to St. Louis and intermediate points. Work will be commenced at once toward connecting the two systems of street railways. A called meeting of the directors of the two companies has been asked for on June 14, at which propositions will be considered for increasing the capital stock of the two companies from $1,000,000 each to $3,000,000 jointly.

CHICAGO, ILL.—What promises to be one of the most important enterprises yet undertaken in the way of electric railway building in Indiana was put under way the other day, when the Chicago and Northern Indiana Railroad Company filed articles of incorporation. This company purposes to build an electric railway from Chicago to Indianapolis, through Lake, Porter, Jasper, Pulaski, White, Cass, Howard, Clinton, Tipton, Hamilton and Marion counties into Indianapolis over a private right of way. The directors of the company are Lester Soule, A. L. Wheeler and Senator Charles N. Thompson, of this city; Henderson E. Davenport, Sheridan; James G. Kemp, Kempton; Martin W. Eikenbury, Russiaville, and Luther McDowell, Young America. The nominal capital stock is $25,000, of which Mr. Soule holds $15,000. It is said, however, that millions are back of the project, and that it has the support of several wealthy men of the State who are not among the incorporators. Mr. Soule is president and general manager of the Globe Construction Company, of Des Moines, Iowa, which holds the contract for building the Indianapolis and Logansport steam road. An official of the company says that the road will operate in competition with all steam roads covering the territory; that freight and passenger traffic will be carried on just the same as on steam roads, and that the line will be equipped with standard passenger cars and Pullman sleepers.

PRINCETON, IND.—The Evansville & Princeton Traction Company has completed a survey of an extension from Princeton to Vincennes. White River will have to be crossed near Hazleton. When this line is built only one gap will remain to be closed up to afford through service between Evansville and Indianapolis. This gap is one of 30 miles between Brazil and Danville.

LAWRENCEBURG, IND.—The Cincinnati, Lawrenceburg & Aurora Electric Street Railway Company has increased its capital stock from $750,000 to $1,000,000, in order to obtain funds to complete the betterments, extensions and changes of route necessary for the successful operation of the business of the company, and for the purpose of increasing its working capital. J. C. Hoover is president and Stanley Shaffer, secretary.

TERRE HAUTE, IND.—The Terre Haute Electric Traction Company has changed its name to Terre Haute Traction & Light Company. The company has also filed amended articles of incorporation thereby enlarging the purposes for which the corporation was formed, and naming additional cities and towns in which, and in the vicinities of which, it is proposed to carry on operations. In short, the company will extend its lines through Clay, Vermillion, Clinton and Greene Counties.

MUSKOGEE, I. T.—The City Council has granted a street car franchise to Capt. Ira L. Reeves and N. A. Gibson.

LEXINGTON, KY.—The Blue Grass Traction Company, operating from Lexington to Paris, Ky., and from Lexington to Georgetown, Ky., has sold $700,000 of 5 per cent. bonds, a considerable portion of which were taken in Cleveland and the balance in Cincinnati and Lexington, Ky. The Cleveland Trust Company is trustee for the mortgage.

BILOXI, MISS.—Capt. W. K. Penny has been granted a charter for the construction of an electric railway between Biloxi and Pass Christian.

PHILADELPHIA, PA.—The directors of the Public Service Corporation have declared the semi-annual dividend on the stock of the South Jersey Gas, Electric & Traction Company and confirmed the lease of the Camden & Suburban Company.

POTTSTOWN, PA.—Application for a charter has been made by the Pottstown & West Chester Improvement Company, which has been formed with a capital stock of $400,000. This is the company of which C. Wesley Talbot, ex-Burgess of West Chester, is president. The plant is to build an electric railway between Pottstown and West Chester.

JOHNSTOWN, PA.—It is reported that the Johnstown Coal & Coke Company, owning mines at Moss Creek, has become interested in the plan to build an electric railway from Johnstown to Spangler and Moss Creek. The mines of the company are at present very inaccessible, and it is said that the company, in connection with local people, will go into the project and finance the deal.

NEW CASTLE, PA.—A complete reorganization has been effected of the Pennsylvania & Mahoning Valley Electric Railway Company, which controls the local and Youngstown systems and about 100 miles of tracks throughout Eastern Ohio. Superintendent M. E. McCaskey is made second vice-president and general manager of the entire system. W. C. Smith, of Youngstown, is now general manager under Vice-President McCaskey. The local offices are made the general offices, and the Youngstown clerical force will be brought here.

WELLSBURG, W. VA.—H. G. Lazcar, of Wellsburg, promoter of the proposed electric railway between Wellsburg and Bethany, is now in New York negotiating with the Westinghouse Company for the construction of the line.

NEW INDUSTRIAL COMPANIES.

THE ARNOLD ELECTRIC MANUFACTURING COMPANY has been incorporated with a capital stock of $3000, by G. L. Clegg, C. H. Crawford and Leon Stroh.

THE GENEVA ELECTRIC COMPANY has been incorporated in Geneva, Ohio, with a capital stock of $5000, by Homer Hood, Marcus Westerman, Lewis H. Young, Abner G. Webb and Harry B. Gregory.

THE CATARACT ELECTRIC SUPPLY COMPANY, with a capital stock of $100,000, has been incorporated at Buffalo, N. Y., the directors being N. S. Hallett, F. T. McDonald and E. B. Collister, Buffalo.

THE PRESSED STEEL POLE COMPANY, of Jersey City, has been incorporated with a capital stock of $125,000. The names of the incorporators are C. L. Wilson, John Roland, N. B. Neagby and E. A. Kelly.

THE AMERICAN GARAGE & MAINTENANCE COMPANY, of New York, has been incorporated with a capital stock of $100,000. The incorporators are J. T. Rainier, P. N. Lineberger and H. U. Kibbe, New York.

THE COMMONWEALTH ELECTRIC COMPANY, of Jersey City, has been incorporated in New Jersey with a capital stock of $100,000. The incorporators are Graham Sumner, Ross A. Mackay and Mark Hyman.

THE F. C. THOMPSON COMPANY has been incorporated in New York for the purpose of manufacturing scientific instruments. The capital stock is $25,000 and the incorporators are F. C. Thompson, F. M. Ashley and Hattie A. Dean, New York.

THE CONSTANT DYNAMO COMPANY has been incorporated at Portland, Me., to manufacture electrical apparatus. The capital stock is $5,000,000, of which $250 is paid in. The officers are: President, Harry L. Cram, of Portland; treasurer, Charles Howard Weston, of Boston.

THE ELECTRIC CONSTRUCTION COMPANY has incorporated at Elkhart, Ind., with a capital stock of $25,000. The company will establish its principal office and plant in Elkhart for the purpose of manufacturing electric batteries and electrical appliances and other mechanical devices. Ernesto Sassenhoff, L. B. Hornbeek and B. R. Reid are the incorporators.

LEGAL.

CLEVELAND FIVE-CENT FARES.—Justice White, of the United States Supreme Court, has handed down a decision affirming the decision of the United States Circuit Court for Northern District of Ohio in the Cleveland (Ohio) Street Railway fare cases. The opinion was favorable to the railway. The cases involved the validity of the ordinance passed by the City Council of Cleveland in 1898, fixing the rate of fare on the street railways at 4 cents cash, or seven tickets for 25 cents. The Supreme Court held that the consolidation ordinance of 1885, fixing fares at 5 cents, constituted a contract binding both on the city and the railway companies.

TELEPHONES IN POOL ROOMS.—Some of the lawyers for the poolroom men have made demands upon the New York & New Jersey Telephone Comapny to replace the telephones which were ripped out of poolrooms by the police recently. The telephone company stated that the matter would be referred to the law department of the company and the contracts examined. Many of the poolroom men had made contracts with the company for a year, and declare that the company must replace the instruments which the police seized or stand suit for damages. It is the intention of the poolroom men to bring such suits, not in the guise of poolroom owners, but as regular subscribers whose contracts have been broken.

CHICAGO TROLLEY FRANCHISES.—A decision, which in effect upohlds the so-called ninety-nine-year act, but restricts application, was announced in Chicago last month by Judges Grosscup and Jenkins in the United States Circuit Court. The decision says the act applies to all ordinances and grants made by the City of Chicago up to the adoption of the city charter in 1875, but does not apply to grants after that date. Mayor Harrison said the city would appeal so as to get a final decision from the United States Supreme Court. The "Ninety-nine-Year Act" is a statute passed by the Illinois Legislature many years ago granting the street car companies in Chicago practically a free hand if the contentions of the companies were accepted. The validity of the act and the scope claimed have been bitterly contested by the city, one of the grounds of attack being the allegation that the enactment was obtained dishonestly.

SECOND-HAND LAMPS ENJOINED.—In the United States Circuit Court for the District of New Jersey the following injunction was granted on May 16th, 1904, by Judge Archbald, in the case of the General Electric Company vs. McKeon et al. "This motion having come on to be heard on the sixteenth day of May, 1904, upon the pleadings and affidavits of both parties filed herein, and having been argued by Charles Neave, Esq., on behalf of the complainant and by William J. Kearns, Esq., on behalf of the defendants, and due consideration having been had, it is ordered that a preliminary injunction issue out of and under the seal of this court directed to the defendants, William F. McKeon and Joseph Conning, strictly enjoining and restraining them and each of them and their servants, employees, agents and workmen from directly or indirectly selling or otherwise disposing of any old or second-hand "Edison" incandescent electric lamps without plainly and unmistakably marking them and each of them with the words "Used and Second-hand," until the further order of this court." It appears that two other preliminary injunctions of similar character have been issued against other persons.

NEGLECT OF ELECTRIC LIGHTING COMPANY.—The Supreme Court of Pennsylvania has recently handed down a decision in the suit of Daltry vs. Media Electric Light, Heat & Power Company, holding as follows: 1. An electric light company is bound to use the highest degree of care practicable to avoid injury to any one liable to come accidentally or otherwise in contact with its wires. 2. Where an electric light company negligently permits its wires to come in contact with the wire of another, thereby causing an accident, it is responsible for the injury resulting. 3. Where an owner of a house procured defendant electric light company, at his own expense, to introduce electric light into the house by running a wire from its line at the gateway across the lawn to the building, and on the removal of such person from the house the company cut off electric connection, but left the wire hanging in connection with the feeder line to the street, it was not relieved from liability to a boy injured by coming in contact with such wire by the fact that it was not the owner. 4. Where an electric light company left a wire connected with its plant hanging from a pole in the lawn of another to within a few inches of the ground, and a boy was injured by coming in contact therewith, it was no defense that the boy was a trespasser on the land at the time of the accident. 5. Evidence in an action against an electric light company to recover for injuries received by coming in contact with a wire of the company is held to sustain verdict for plaintiff.

OBITUARY.

DR. ADOLPHO ASCHOFF, of the Brazilian electrical engineering and contracting firm of Aschoff & Guinle, of Rio de Janeiro, which concern represented the interests in that part of the world of a score of leading American electrical manufacturing firms, including the General Electric Company, is dead. When last in this country, where he had many warm friends and admirers, Dr. Aschoff was in very poor health. His first visit to the United States was made in 1893 when he was attached to the Brazilian Commission at the Chicago Exposition. He leaves a wife and one daughter.

WILLIAM WALLACE.—Mr. William Wallace, who was one of the founders of the firm of Wallace & Sons, at Ansonia, Conn., died at his home in Washington, May 20, in the eightieth year of his age. Mr. Wallace was a native of England, where he was born in 1825. He was at one time associated with Professor Moses G. Farmer, and in 1876, at the Centennial Exposition, he brought out the Farmer-Wallace dynamo machine with which the buildings were successfully lighted, this being one of the earliest applications of electric lighting in this country. He made several improvements in arc lighting apparatus. Mr. Wallace was greatly interested in scientific matters and had a laboratory fitted up in his house for experimental work. For some years he lived quietly in Washington. He is survived by a son, who lives in Rochester, N. Y., and a daughter who has been his companion for several years. In February, 1893, Mr. W. J. Hammer contributed to the columns of THE ELECTRICAL ENGINEER, of which this journal is the successor, a brilliant series of articles on Mr. Wallace's work, profusely illustrated with original photographs and other material. In these articles the interesting fact is mentioned that Mr. Wallace was an Englishman, having been born in Manchester, March 16, 1825, and coming to America with his parents in 1832. His people were among the early settlers of Ansonia, Conn., where they developed pioneer branches of the copper and brass industry. It was out of such work that grew the connection of Mr. Wallace with electrical affairs and his close intimacy with such men as Farmer, Edison, Sprague, Prof. Barker and many other celebrities. The first Wallace dynamo machine dated back to 1874, and at the Centennial Exposition as well as at later exhibitions several interesting pioneer types of such machinery produced at the Wallace works were shown. In 1875 Mr. Wallace began making arc dynamos and some of his arc lamps, among the earliest known in the country, were used at the Centennial. In fact, Mr. Wallace invented and constructed the first arc lamp made in this country, with plate carbons adjustable by hand. Mr. Wallace also was the first here to run arc lamps in series, and one of the first four operated in this manner is now among the relics in the possession of Columbia University, New York City. The experimenting done by Mr. Wallace with arc lamps and with other kindred apparatus would fill a volume. The great electro-magnets made for West Point and for the Stevens Institute of Technology were of his construction. Another branch of work carried out by Mr. William Wallace with his brother, Thomas, was the construction and operation of a huge electro-deposition plant for making the compound copper-plated steel wire used by the Postal Telegraph Company between New York, Washington, Chicago and St. Louis for Elisha Gray's harmonic telegraph. In these baths over 100 miles of steel wire was treated at the time. Mr. Wallace was himself very much interested in electrical history and development and was a collector of its relics and literature. He was a delightful man to know.

EDUCATIONAL.

CASE SCHOOL OF APPLIED SCIENCE.—The inauguration of Dr. Chas. Sumner Howe as president of Case School of Applied Science, of Cleveland, Ohio, was held in that city May 10 and 11. The inaugural exercises were attended by more than a hundred delegates from over seventy-five leading colleges, technical schools, universities, engineering societies and scientific journals. Euclid Avenue Congregational Church, where the exercises were held, was filled to overflowing. Dr. Worcester R. Warner, representing the Board of Trustees, made the opening address and was followed by President Henry Churchill King, of Oberlin College; President Ira Remsen, of Johns Hopkins University; President H. S. Pritchett, of the Massachusetts Institute of Technology; Mr. John R. Freeman, of the American Society of Mechanical Engineers, and President Charles F. Thwing, of the Western Reserve University. In his inaugural address Dr. Howe spoke on "Does a Technical Course Educate." After an informal luncheon the Case School Laboratories and Shops were opened for the inspection of delegates. An inauguration banquet was held at the Hollenden Hotel in the evening. Case School of Applied Science is one of the most progressive and best equipped technical schools in the Central West. It was founded by Leonard Case, Feb. 24, 1877, and the present school was opened for instruction September 15, 1881. At the inauguration exercises it was announced that Mr. John D. Rockefeller had presented the school with $200,000 to be used in improving its facilities.

PERSONAL.

E. H. DAVIS.

MR. ERNEST H. DAVIS, whose portrait we present herewith, was elected president of the National Electric Light Association at Boston last week, as already noted in these pages. Mr. Davis was born in Philadelphia Nov. 13, 1859. He was educated at the public schools of that city and was admitted to practice at the bar. He had always had a taste, however, for industrial and transportation enterprises, and, after securing some railroad experience, became, in 1894, connected with the Lycoming Electric Company and the Williamsport Passenger Railway Company, of Williamsport, Pa. More latterly he became associated with the Edison Electric Illuminating Company and remains active in the management of all these various enterprises. For the last few years, Mr. Davis has filled with remarkable success and efficiency the secretaryship of the Association. Each incoming president has found in him an official posted as to its affairs and enthusiastic for its advance, and the Association has never enjoyed greater prosperity and growth than during the term of Mr. Davis' incumbency. In a post of responsibility and delicacy he has made innumerable friends by his tact, energy and kindly disposition, and his election to the presidency, while quite unexpected, has been hailed everywhere with marked approval.

D. FARRAND.

MR. DUDLEY FARRAND, the new secretary of the National Electric Light Association, whose election to that position was gazetted in these pages last week, is prominently known in the electric light affairs of the State of New Jersey, where he was born at Bloomfield in 1869, a member of the old Farrand family of that State, Michigan and Pennsylvania. After education in the Bloomfield public schools he attended the Newark Academy, graduated in 1887, and then entered Princeton University for the class of '91, but owing to circumstances beyond his control was compelled to abandon his college plans. He then became connected with the Newark Electric Light and Power Company, and with Mr. P. N. Jackson was one of the mainsprings of that large enterprise. While still a young fellow of only twenty-one, he was made a director in the company, and given responsibility for a large part of the work. In 1896 he was made assistant general manager of the People's Light and Power Company and general manager in 1897, controlling directly all the concerns which constituted the People's Light and Power Company. In the spring of 1899 the United Electric Company of New Jersey was formed, of which again Mr. Farrand became general manager, with a territory including several counties of the State, and embracing latterly scores of municipalities. More lately the Public Service Corporation of New Jersey consolidated the lighting enterprises of that region, with the street railway enterprises, and Mr. Farrand has again continued in the direction of that entire department, which embraces also the generation of current for a large trolley network. Mr. Farrand is a man of considerable public spirit, and outside his official connection with other electrical enterprises is a member of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineeers. While his leisure is limited, his nearness to New York will enable him to give a good deal of time to the duties of the office, which will still be carried on directly under the active and highly efficient charge of Miss Harriet Billings, assistant secretary.

MR. W. K. PALMER, M. E., consulting engineer, Kansas City, Mo., has removed his office from 402 Lyceum Building to 718 Dwight Building.

MR. G. B. LELAND, who was formerly with the Norwich, Conn., Gas & Electric Company, has assumed the management of the Stamford, Conn., Gas & Electric Company.

MR. S. R. BOTTONE has written for Macmillan Company a pamphlet all about radium, which they have recently issued. It deals with the properties and uses of the new "element."

MR. MARK A. REPLOGLE, having very recently perfected his new differential water-wheel governor, has been retained by the Replogle Governor Works as chief engineer, and the manufacture and sale of this new machine will begin at once.

MR. GEORGE GREENWOOD, for several years resident engineer of the Jalapa Railway & Power Company, Mexico, has been appointed to represent the interests of the General Electric Company on the Pacific coast of the Southern Republic.

MR. J. G. SPLANE, president of the Pittsburgh and Allegheny Telephone Company, writes to the effect that he is not responsible for the recent public utterances attributed to him as to an impending big independent telephone consolidation.

J. B. ALLAN.

MR. JOHN B. ALLAN, formerly vice-president and general manager of the Allis-Chalmers Company, will shortly commence his duties as Western manager of the Westinghouse Machine Company with headquarters at 171 LaSalle Street, Chicago, having direct charge of entire Western district. Mr. Allan has been prominently associated with the Allis-Chalmers Company for the past twenty-four years and has filled positions of progressively increasing importance, including those of sales manager, general manager and vice-president. Mr. Allan was born in 1860 at Davenport, Ia., and received a common high school education in his native city, followed by a course at the Wooster Polytechnic Institute, from which he graduated in 1880 as a mechanical engineer. He immediately commenced practical work, entering the service of the Edward P. Allis Company, shortly after leaving college, wherein he was successively employed as draughtsman, machinist and erecting superintendent. During this time, Mr. Allan also had charge of making economy tests of engine and steam plants. In January, 1895, the company opened a general sales office in Chicago, of which Mr. Allan was made manager, the engineering as well as the selling departments coming under his supervision. Mr. Allan's subsequent career has been one of continuous advancement, and his wide acquaintance and popularity in the field to which he has devoted his main efforts peculiarly fit him for assuming his new duties in this same field. He is a prominent member of the American Society of Mechanical Engineers and the Engineers' Club of New York.

MR. C. O. BAKER, president of Baker & Company, of Newark, N. J., and New York City, N. Y., the well-known refiners and artisans in platinum, gold and silver, sailed on Wednesday, May 18th, on the White Star steamship *Cedric*, for his annual trip abroad.

MR. J. B. WHITE, of the British electrical engineering and contracting firm of J. G. White & Company, Limited, London, is to be married early this month. The bride will be Miss Harriet Stevens, of Brooklyn. The ceremony will take place in the British metropolis.

MESSRS. T. F. MANVILLE, president of H. W. Johns-Manville Company, New York, E. B. Hatch, president of Johns-Pratt Company, Hartford, and J. W. Perry, manager of the electrical department of the former company, sailed for England on April 26th and will return about June 10th.

MR. J. W. F. BENNETT, formerly associated with the Thompson-Starrett Company, has been appointed to a responsible position in the new building department recently established by the electrical engineering and contracting firm of J. G. White & Company, Limited, of London, England, under the management of Mr. R. A. Denell, lately manager of the D. H. Burnham Company, of Chicago, Ill.

DR. ELVIO SOLERI, assistant to Prof. Morelli, professor of machine design at the Museo Industrialeo of Turin, has arrived in the United States and will represent the Italian government at the World's Fair in the capacity of technical delegate. Dr. Soleri will also represent at the Fair the Museo Industrialeo, two Italian technical journals, and make reports to several important Italian manufacturing companies on technical exhibits.

MR. FRANCIS S. THAYER, superintendent of the Westerly Gas & Electric Light Company, has been selected as superintendent of the Norwich, Conn., municipal lighting plant, by the board of commissioners. He was for 13 years with the Narragansett Electric Company, nine years of which period he was superintendent of their gas and electric plants at Warren and Bristol. Mr. Thayer is about 37 years of age. He is succeeded at Westerly by Mr. F. N. Clark, who has been with the plant there for seven years past.

MR. G. MARCONI made recently an interesting statement to the *Wall Street Journal*, resuming his recent work, especially with regard to the proposed system of marine news on the Atlantic. He said also: "The Italian government has detailed an officer of the navy to attend the St. Louis Exposition, and there give an account and exhibit of the long distance work accomplished on the voyage of the *Carlo Alberto*. He will have with him the original messages, the tape and the records. On that voyage we transmitted messages to Poldhu, to Kronstadt, Russia; Naples and Spezia, Italy, and to Cape Breton. He has been instructed to thoroughly explain to representatives of the American government the results of our experiments on that voyage."

MR. ARTHUR WEST, formerly engineer with the Allis-Chalmers Company, has joined the staff of the Westinghouse Machine Company as chief engineer, with headquarters at East Pittsburg. Mr. West is eminently fitted for his new position by his experience with the Allis-Chalmers Company, with whom he has been associated for about seventeen years in various positions. For several years past he has had full charge of their entire pumping station work. Mr. West was born at Milwaukee, Wisconsin, in March, 1867, and received a common school education at Milwaukee public schools, supplementing this by a technical course at the University of Wisconsin, from which he graduated in the class of 1887. This was followed by post-graduate work at the same institution, and he then entered the employment of the Edward P. Allis Company as a machinist, and his career with that concern has been one of continuous advancement. Some of the positions which he has filled are those of erecting engineer, assistant to shop superintendent, assistant superintendent, private engineer for Edwin Reynolds in his special work, general trouble engineer on all steam engine work, salesman in pump department, engineer of tests, manager of pump department, and finally assistant chief engineer. He is a member of the American Society of Mechanical Engineers and the Engineers' Club, of New York. Mr. West recently started for Europe to investigate the most recent practice of British and Continental engine builders.

Trade Notes.

THE J-E-M SHADE-HOLDER COMPANY has removed its office from 503 Fifth Ave., to 13 East Thirtieth Street, New York.

THE WESTINGHOUSE ELECTRIC & MFG. COMPANY has opened a sub-office at Room No. 1110 Hibernia Bank & Trust Building, New Orleans, La.

HOTEL TELEPHONES.—The Lambert Schmidt Telephone Mfg. Company, Weehawken, N. J., has just shipped a 270-drop central energy switchboard and telephones to the Grand Hotel at Grand Hotel Station, N. Y.

STANDARD TELEPHONE & ELEC. COMPANY, of Milwaukee, has removed its offices and factory from Madison to that city to secure better facilities generally. It has most advantageous quarters at Michigan and Jefferson Streets, with larger plant and new machinery.

AMERICAN STONE CONDUIT COMPANY, of 94 LaSalle Street, Chicago, has issued a neat little brochure as to stone pipe for underground conduits. It describes and illustrates a large variety of work for electrical purposes, and shows how the thing is done, in general and in detail.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is advertising as headquarters for heating apparatus and is claiming that the central stations may make one blade of business grow where none grew before by pushing such appliances. There is a good deal of truth in this assertion.

NERNST LAMPS.—A recent publication of the Nernst Lamp Company is a handsome little pamphlet entitled "44 and 55-watt Nernst Lamps for Alternating-Current Circuits." Some excellent illustrations show the details of the lamp, which is of the single-glower, helical-heater type.

TEMPERING AND ANNEALING FURNACE.—F. W. Braun & Co., Los Angeles, Cal., have issued a pamphlet devoted to the Braun portable forge and tempering furnace which contains some excellent practical information on the subjects of annealing, tempering and case-hardening of value to those interested in these processes.

ONE FAD in electric lighting is to take advantage of the decorative effects possible with the Packard Zenith lamps. The rush of business at the present time is partly the result of orders for dining-room, pavilion and porch lighting at summer resorts. The Electric Appliance Company, Chicago, general western agents, has special circulars on these lamps.

DUNCAN METERS.—The latest bulletin of the Duncan Electric Mfg. Co., Lafayette, Ind., is devoted to the Duncan integrating wattmeter for direct currents, which is illustrated by excellent cuts showing every detail. Among the points brought out especially are the new means employed for friction compensation, the visual bearing and non-oxidizing commutator.

COLUMBIA INCANDESCENT LAMP CO., St. Louis, Mo., has issued in very neat and tasteful form a little brochure entitled "A Wallet Full of Wisdom." It is made up in wallet form as to cover, and the contents deal with the qualities of the Columbia lamp. Views are given of various departments of the factory, and there are illustrations also of different types and sizes of lamps.

FAIRBANKS, MORSE & COMPANY, Franklin and Monroe Streets, Chicago, have just issued their pumping machinery catalogue No. 480. It represents marked and consistent advance and improvement in pump design, and shows apparatus competent to fill the wants of a wide range of users in the field of power equipment, etc. Copies of this valuable catalogue can be obtained upon application by all interested.

PERKINS POWER PRESSES are the subject of a handsome and elaborate catalogue issued by the Perkins Machine Company, of Warren, Mass. It has an ornamental cover in stiff boards, and its 176 pages embrace a large variety of presses, which are shown in all their details, many of the products being also exemplified. The descriptions are in many instances full and elaborate to a degree, and specifications are also given.

WORLD'S FAIR LITERATURE.—The Electric Controller & Supply Company, Cleveland, Ohio, has prepared for distribution at the World's Fair nine bulletins describing some of its more important specialties, namely, magnetic switches and clutches, lifting magnets, solenoids and electromagnets, controllers, brakes, resistance units and electrical fittings. The pamphlets are bound in tinted covers, presenting an unusually attractive appearance.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has taken a residence at 4472 Forest Park Boulevard, St. Louis, for the use of members of its staff attending the Louisiana Purchase Exposition. The Company's exhibit, which is the largest and most comprehensive that has ever been made by a storage battery company, is practically complete. It contains many interesting features, showing the recent developments in storage battery practice.

THE JOHN H. McGOWAN COMPANY, Cincinnati, Ohio, reports a brisk trade, especially in the municipal work. It now has on its books orders for pumping machinery aggregating a total of nearly 100,000,000 gallons capacity, from the following cities: Ottawa, Ohio; Vermillion, Ohio; Johnstown, Ohio; Murray City, Ohio; Bardstown, Ky.; Pemberton, S. C.; Winston-Salem, N. C.; Kinston, N. C.; Hawkinsville, Ga.; Dalton, Ga.; Winona, Miss.; Columbus, Miss.

HAZARD MFG. COMPANY, of Wilkesbarre, Pa., has now headquarters at 71-73 West Adams Street, Chicago, and Mr. Robert H. Peet, who for three years past has had charge of the sale of insulated wires and cables made by the concern, has been made sales agent for its entire product in Chicago and Western territory. With him will be associated as assistant Mr. Homer A. Wessel, Jr., from the factory. A large stock will be carried. The Hazard products have a fine reputation in the West.

FREDERICK PEARCE, 18 and 20 Rose Street, New York City, has just issued catalogue No. 11 on telegraph and electrical apparatus and supplies. It is very complete in all the departments of telegraphy, telephony, light and power, giving special attention to the Pearce specialties in knife switches, panel boards, etc. A number of views of the offices and factory are given, and the 377 pages are profusely illustrated. It is altogether a handsome and useful publication for the industry and trade.

THE F. BISSELL COMPANY, Toledo, Ohio, builders of switchboards for lighting and power, reports that its trade in these boards has increased so largely that it has become necessary to extend its facilities and that it has recently placed large orders for additional stocks of marble and slate. The Bissell Company has found such a large demand for information on its switchboards that it has prepared a new handbook on switchboards which will be sent free of expense to anyone interested in switchboards.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY has settled in its new building, 184 Lake St., Chicago. Its prominent location and its fine new store and sales room, with increased shipping facilities enable it to take care of a largely increasing business with very much better satisfaction to customers. This company must be reckoned as a factor in the electrical supply business. Its customers are found all over the country and in foreign lands. It has quite a line of first-class specialties such as Eureka flexible conduit. Toerring arc lamps, Shedd oscillating fans, etc., etc. It is carrying a very large stock of general supplies and is increasing its line constantly by putting in new specialties as fast as perfected.

DOUBLEDAY-HILL ELECTRIC COMPANY, Pittsburg, Pa., has issued in its general catalogue No. 4 of electrical supplies one of the most comprehensive volumes as to electrical apparatus given to the trade of late years. It is a massive volume of 1068 pages printed on good paper in clear type and profusely illustrated with cuts of every class of electrical apparatus for which there is a market. This apparatus does not merely include the smaller varieties of electrical supplies, but ranges into the larger material, such as generators and motors, and includes even gas engines. The information given is well classified and is remarkably complete and specific, including sizes, prices, code words, descriptive matter, etc. In some of the instances the text is very full and useful. The owner of this catalogue is fortunate. To see it is to want it, and to obtain it means daily use for any busy central station manager, superintendent of isolated plants, telephone man or telegrapher.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 24, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Att'ys, 140 Nassau St., N. Y.]

758,701. ELECTRIC BURGLAR AND FIRE ALARM; Solomon Schwarzchild, Rochester, N. Y. App. filed Feb. 24, 1902.

759,237. CIRCUIT CHANGER; Charles C. Cadden, Cleveland, Ohio. App. filed June 15, 1903. (See page 1088.)

759,796. LIGHTNING-ARRESTER; John C. Barclay, New York, N. Y. App. filed Sept. 9, 1903. (See page 1088.)

760,399. SELECTIVE SIGNAL SYSTEM; Fred C. Penfield and Olin Templin, Lawrence, Kan. App. filed March 17, 1902. (See page 1088.)

760,426. ALTERNATING CURRENT WATTMETER; Frank Conrad, Edgewood Park, Pa. App. filed Feb. 20, 1903. The meter is provided with two quadrature adjusting coils connected together in parallel and means for transferring resistance from the circuit of either of said coils to that of the other.

760,480. SYSTEM OF ELECTRICAL DISTRIBUTION; John S. Peck, Pittsburg, and Joseph W. Farley, East Pittsburg, Pa. App. filed July 3, 1903. Means for varying and regulating the voltage delivered to the three-phase side of a system in which transformers are employed for transforming two-phase energy into three-phase energy.

760,539. PROCESS OF RECOVERING METALS FROM ORES OR SANDS; William J. Jory and Joseph H. Jory, San Francisco, Cal. App. filed April 7, 1903.

760,549. PLUG AND SPRING JACK SWITCH; Frank B. McBerty, Evanston, Ill. App. filed Jan. 6, 1900. Improvements in the details of construction.

760,554. MANUFACTURE OF SULFID OF ALUMINUM AND ALLOYS OF ALUMINUM; Miyagoro Onda, Nagoya, Japan. App. filed Oct. 14, 1903.

760,556. MOTOR CAR; Alexander Palmros, Columbus, Ohio. App. filed Sept. 5, 1900. An electric locomotive in which the side frames are chambered out to accommodate the wheel-suspension devices.

760,561. PROCESS OF MANUFACTURING HARD POROUS ELECTRODES FOR BATTERIES; Heinrich Paul Rudolf Ludwig Forske and Gustav Adolph Wedekind, Hamburg, Germany. App. filed Nov. 18, 1903.

760,565. ELECTRICAL SWITCHING APPARATUS; Walter J. Richards, Milwaukee, Wis. App. filed April 29, 1903. Details in the switching apparatus for stopping and starting the motor driving an air compressor.

760,568. ELECTRIC INDICATOR; Edward Sadler, Upper Tooting, England. App. filed May 16, 1903. An annunciator in which a disk previously set is restored upon the sending of another signal to operate a different disk.

760,573. TELEPHONE-EXCHANGE SYSTEM; Charles E. Scribner, Jericho, Vt. App. filed Sept. 15, 1902. (See page 1088.)

760,574. ELECTRIC POLE CHANGER; Charles E. Scribner, Jericho, Vt. App. filed Sept. 15, 1902. A pole changer for ringing current in telephone exchanges arranged so that a resistance will be included in the circuit at the time contacts are broken, to prevent sparking.

760,577. CLUTCH MECHANISM; Severn D. Sprong, New York, N. Y. App. filed Oct. 29, 1903. A magnetic clutching apparatus automatically ensuring a moderate advancing movement of a planer and the automatic reversal and more rapid return movement.

760,591. FAN MOTOR SUPPORT; Ernest P. Warner, Chicago, Ill. App. filed Sept. 8, 1902. A construction of ball and socket joint whereby the motor and fan can be set at any angle.

760,598. POLE CLAMP OR COUPLINGS; Clyde B. Wynegar, Greenwood, Ind. App. filed March 7, 1904. A coupling for a trolley pole, permitting the latter to be twisted, so as to bring the wheel into the plane of the wire.

760,601. HIGH TENSION OIL SWITCH; Henry P. Ball, New York, N. Y. App. filed Feb. 25, 1902. A switch designed for safely handling high tension, large quantity currents and which under ordinary conditions of service will not be injuriously affected by the arc produced upon breaking the circuit or if injured by an excessive arc, may be readily and quickly repaired.

760,602. OIL SWITCH; Henry P. Ball, New York, N. Y. App. filed March 10, 1902. Consists essentially in locating in separate insulated oil-wells, the terminals of a conductor forming a leg of a polyphase distribution system.

760,603. ELECTRIC SWITCH; Henry P. Ball, New York, N. Y. App. filed July 5, 1902. Improvements in various features of construction, the mechanism for controlling the switch from a distance and the mechanism for shifting the circuit connections of the switch slightly before the opening or closing of the switch.

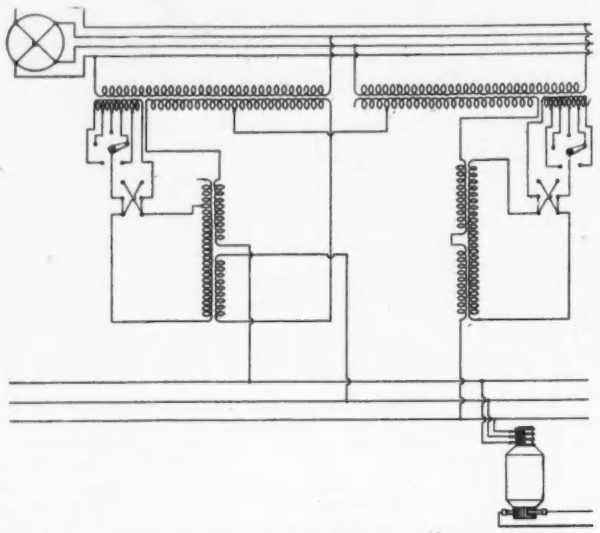
760,611. PRINTING TELEGRAPH RECEIVER; George A. Cardwell, New York, N. Y. App. filed April 11, 1903. General improvements in page printers.

760,620. INSULATOR BRACKET; Francis J. Grant, Chicago, Ill. App. filed Aug. 15, 1903. Details.

760,641. TROLLEY POLE; Alfred W. Morgan, Longbeach, Cal. App. filed Nov. 16, 1903. Details.

760,643. THIRD RAIL GUARD FOR ELECTRIC RAILWAYS; Vincent M. Newman, Bayside, N. Y. App. filed Feb. 16, 1904. The plow enters a slot in the guard to engage the third rail and sections of one side of the guard are hinged to permit the removal of the plow when necessary.

760,656. ELECTRIC TRACK SWITCH OPERATING MECHANISM; Charles W. Squires and James B. Squires, Springfield, Mass. App. filed Jan. 20, 1903. Supplemental switch mechanism for determining which of a pair of solenoids shall be energized to actuate the switch tongue.



760,480.—System of Electrical Distribution.

760,657. PORTABLE ELECTRIC HAND LAMP; George Stein, New York, N. Y. App. filed July 18, 1903. A cylindrical casing containing battery and lamp with details of a circuit controller.

760,679. CIRCUIT BREAKER; John Burry, Ridgefield Park, N. J. App. filed Aug. 30, 1902. A telegraph line circuit breaker consisting of two springs under tension to press normally against each other, an electromagnet fer operating one spring to open the circuit and a pointed key past whose point the circuit may be remade or be broken by operating the key.

760,711. AUTOMATIC TELEPHONE SYSTEM; James C. Slater, St. Louis, Mo. App. filed March 10, 1902. (See page 1088.)

760,712. STORAGE BATTERY PLATE; Edward Wanton Smith, Philadelphia, Pa. App. filed Sept. 10, 1903.

760,713. AUTOMATIC REGULATOR FOR ELECTRIC GENERATORS; William A. Turbayne, Lancaster, N. Y. App. filed Sept. 8, 1903. In railway car lighting where the dynamo is driven from the axle, the dynamo is mounted upon a carriage to be adjustable bodily for altering the tension of the belt. The carriage is moved automatically and also by hand when necessary.

760,714. SYSTEM OF ELECTRICAL DISTRIBUTION; William A. Turbayne, Lancaster, N. Y. App. filed Nov. 2, 1903. Improvements for automatically varying the strength of the field of the dynamo to regulate its output, in a car lighting system.

760,736. TROLLEY POLE HEAD; John E. Greenwood, Utica, N. Y. App. filed Sept. 25, 1903. Two wheels mounted in tandem on independent pivoted frames.

760,737. SAFETY CLAMP FOR RAILS; Thomas J. Harleman, Packerton, Pa. App. filed March 28, 1904. A bar having special connecting clamps at each end for electrically bridging the rails of a railway when safety signals are to be set.

760,740. MEANS FOR SAFELY CONDUCTING ELECTRICAL CURRENTS; Edward A. Jarvis, Port Richmond, N. Y. App. filed Dec. 16, 1903. A third rail is housed in a conduit having a sectional metal roof and connecting armatures are arranged to be moved by a magnet on the vehicle, so as to connect the rail with the roof, whence the current is taken by the shoe.

760,787. ELECTRIC MAIL AND PACKAGE CARRYING DEVICE; Edward G. Hamilton, Richmond, Ind. App. filed July 28, 1902. An electric mail and package carrying device adapted to travel automatically in either direction upon a pair of track wires.

760,794. ELECTRICAL BATHING APPARATUS; Robert S. Lawrence, Boston, Mass. App. filed Aug. 3, 1903. The tub is provided with electrodes so placed as to direct the current through the body of water.

760,798. CIRCUIT BREAKER; Andrew C. Miller, Corona, Cal. App. filed May 19, 1902. Details of a device intended to give a signal when the rotation of a shaft ceases.

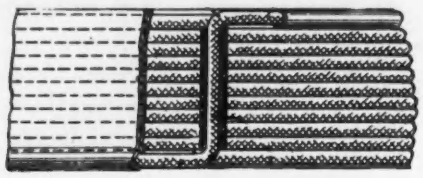
760,801. AUTOMATIC TROLLEY CONTROLLING DEVICE; Horace W. Nichols, Philadelphia, Pa. App. filed Sept. 1, 1903. A winding drum and ratchet arrangement controlling the cord.

760,810. MOTOR VEHICLE; Semple S. Scott, St. Louis, Mo. App. filed Aug. 5, 1903. A chair or small vehicle electrically operated and provided with means for stopping the motor automatically in case of a collision with any object.

760,813. ELECTRIC PRINTING MACHINE; David G. Smyth, Hartford, Conn. App. filed Feb. 16, 1903. Details.

760,815. ELECTRIC SWITCH; Frank Stevens, Philadelphia, Pa. App. filed Dec. 30, 1903. A two-button push switch contained in a box adapted to be set flush in the wall.

760,822. CLUTCH; Walter S. Timmis, Brooklyn, N. Y. App. filed Dec. 9, 1902. A clutch used in connection with a machine for producing, assembling or printing a line of characters; the clutch automatically disconnects the driven shaft from the main shaft at the end of each line, whereby the mechanism for printing will be at rest during the return of the paper carriage to commence a new line.



761,039.—Insulation for Transformer Coils.

760,828. TROLLEY; John S. Weckman and Robert J. Millard, Carnegie, Pa. App. filed Oct. 17, 1903. Details.

760,846. ELECTRIC RAILWAY SWITCH; Rupert L. Border, Pittsburg, Pa. App. filed Oct. 15, 1903. Details.

760,850. BLOW OUT CHUTE; Fred B. Corey, Schenectady, N. Y. App. filed Oct. 16, 1902. Metal plates contained within a passage in which the fuse is located are magnetized by the current traversing the fuse and furnish a field to destroy any arc that might form on the blowing of the fuse.

760,895. ELECTRIC CLOCK STRIKING MECHANISM; Emil Meyer, Swissvale, Pa. App. filed Sept. 24, 1903. Details.

760,897. STORAGE-BATTERY PLATE; Achille Meygretm, Paris, France. App. filed June 29, 1903.

760,947. ELECTRIC BOND FOR RAILWAY RAILS OR OTHER CONDUCTORS; John S. Alexander, New York, N. Y. App. filed Feb. 25, 1903. Two recesses in the abutting ends of the rails together form a chamber having a contracted opening at the surface of the rail; a spreader is placed in the chamber and a forked conductor is then driven through the narrow opening and forced into good contact with the rails by the spreader.

760,955. ELECTRIC SIGNALING SYSTEM AND APPARATUS EMPLOYED THEREIN; Robert G. Callum, Washington, D. C. App. filed Oct. 11, 1902. The object is to automatically notify central office of the breakage of a spring in any of the signaling instruments.

760,970. MEANS FOR CONTROLLING ELECTRIC CURRENTS; Isidor Deutsch, Montreal, Canada. App. filed April 30, 1902. Improvements in various features of a train lighting system.

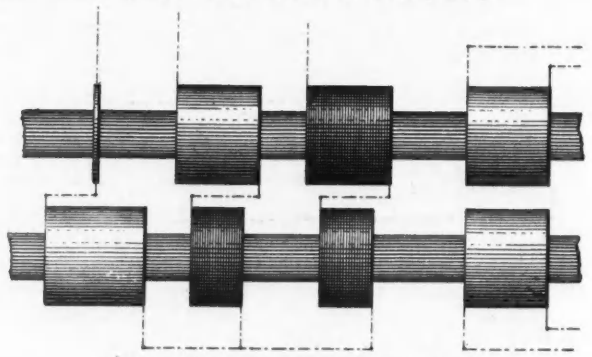
760,976. ELECTRIC SIGNAL SYSTEM: Otto Ernst, Larchmont, N. Y. App. filed Sept. 22, 1903. Details.

760,988. ELECTRICALLY CONTROLLED SWITCH; William H. Hillyer, Atlanta, Ga. App. filed Jan. 21, 1903. Details of the circuit mechanism whereby the car automatically takes current from the trolley wire to actuate the magnets which control the switch tongue.

761,000. TROLLEY; James A. Lavery, New York, N. Y. App. filed Nov. 7, 1903. Two spring-actuated guard-fingers for retaining the wheel upon the wire are controlled by a cord.

761,003. CONTROLLING MEANS FOR ELECTRIC CIRCUITS; Julius K. Lux, St. Louis, Mo. App. filed June 25, 1903. Details.

761,012. AUTOMATIC REGULATOR FOR ELECTRIC GENERATORS; Marcellus R. Shedd, Lancaster, N. Y. App. filed Sept. 8, 1903. Improvements in the regulator described in U. S. Patent 705,487.



12,223.—Alternating Current Transformation.

761,026. CALL BOX; John C. Barclay, New York, N. Y. App. filed Jan. 27, 1904. The object is to adapt ordinary messenger call boxes for use both as alarm boxes and as watchman signal boxes; this is done by a simple attachment to the call box.

761,029. APPARATUS FOR THERAPEUTICAL PURPOSES; Fred H. Brown, Los Angeles, Cal. App. filed March 28, 1904. A belt having two or more electrically energized vibrators relatively attuned to give off harmonic vibrations to the body of the wearer.

761,039. INSULATION FOR TRANSFORMER COILS; Charles Le G. Fortescue, Wilkinsburg, Pa. App. filed Sept. 29, 1903. The lead at the end of one layer which passes across the turns to begin the next layer, is inclosed in an insulating sleeve.

761,044. METHOD OF PURIFYING WATER; Virgil M. George, Youngstown, Ohio. App. filed Jan. 8, 1904.

12,223. ALTERNATING CURRENT TRANSFORMATION; Maurice Hutin and Maurice Leblanc, Paris, France. App. filed April 20, 1904. A method of generating electrical energy which consists in producing two separate alternating magnetic fluxes in quadrature and generating by the inductive influence of these fluxes three or more alternating working currents, dephased with reference to each other.

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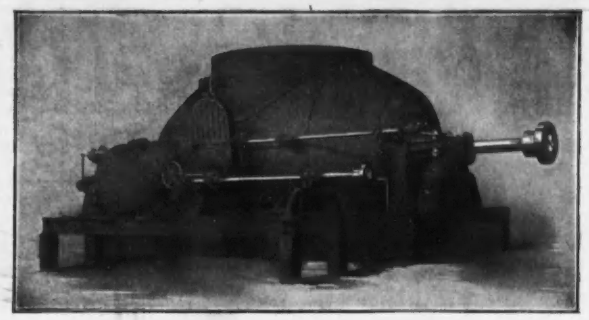

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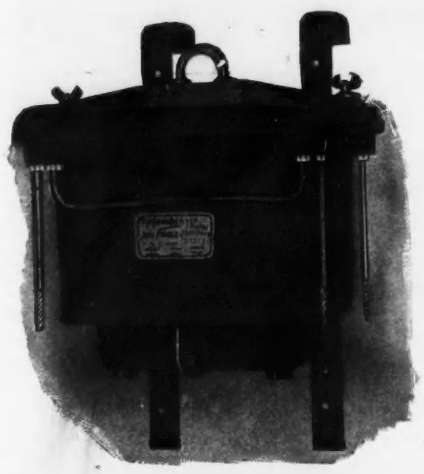

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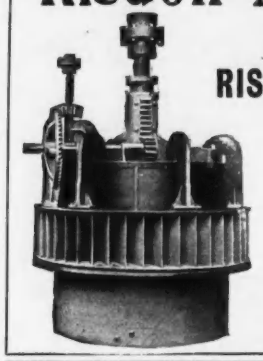

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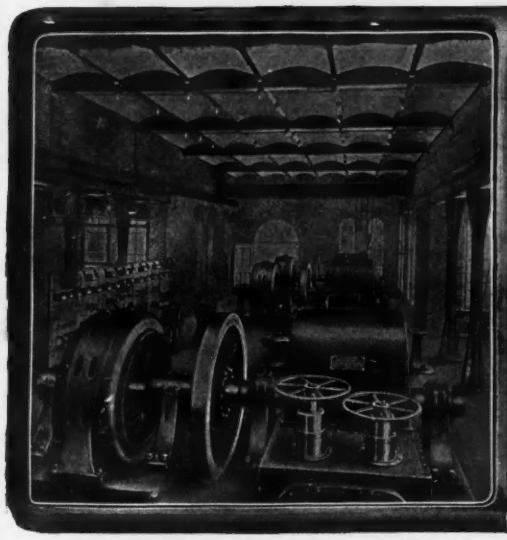

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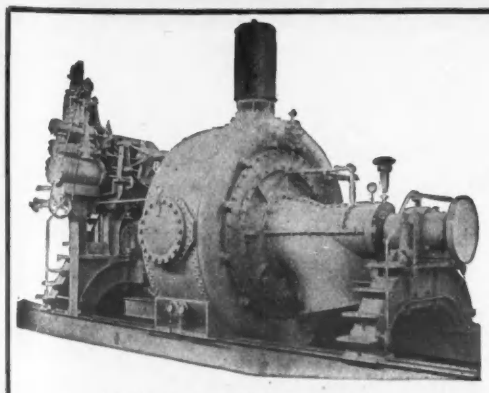

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The illustration shows the large NIAGARA design, HORIZONTAL SHAFT TURBINES recently installed by us, for the NIAGARA FALLS HYDRAULIC POWER & MFG. CO., Niagara Falls, N. Y. Tests conducted by competent engineers developed as follows:

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213 ft.	½	257 r.p.m.	1750	95%	.730%
213 "	¾	257 "	3000	95%	.856%
213 "	Full	257 "	3500	95%	.815%

These results have never been equalled by any turbine of the Horizontal Shaft Design, operating under equally HIGH HEADS. The test was made AFTER TURBINES WERE INSTALLED, direct coupled to Generators. Francis' weirs and formulæ for discharge were used. The original test reports on file at our offices. These turbines are all fitted with our SAMSON BALANCED GATES. Note especially the UNIFORM SPEED at ALL GATEAGES.

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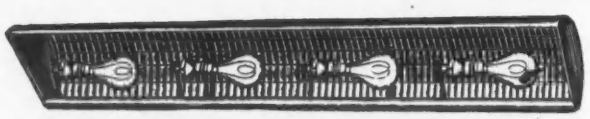

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